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ABSTRACT

This series of learning activity packages focuses on three areas of tractor mechanics: (1) maintaining and servicing the engine, (2) lubricating the tractor, and (3) painting the tractor. Each of the nineteen illustrated learning activity packages follows a typical format: introduction, directions, objectives, learning activities, tools and equipment needed, materials and supplies needed, safety, instructions, student self-check, check-out activities, and final instructor checklist. (LRA)

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TRACTOR MECHANICS

MAINTAINING AND SERVICING THE ENGINE

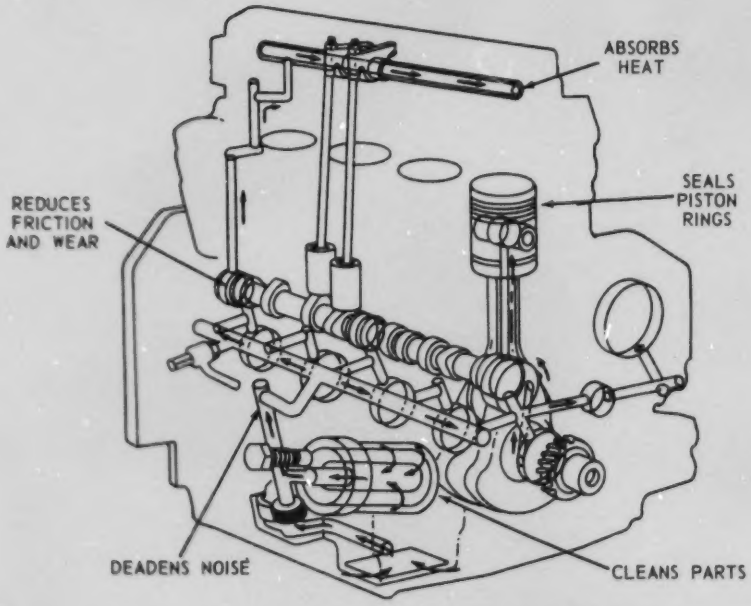
LEARNING ACTIVITY PACKAGES 78 - 89

LUBRICATING THE TRACTOR

LEARNING ACTIVITY PACKAGES 90 - 94

PAINTING THE TRACTOR

LEARNING ACTIVITY PACKAGES 95 - 96



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TRACTOR MECHANICS

Learning Activity Package Number	Objective Numbers	Learning Activity Package Title
DUTY: MAINTAINING AND SERVICING THE ENGINE		
78.	123, 113, 96, 126	Servicing the Valve Assembly
79.	122	Replacing Rocker Arms
80.	92	Adjusting Valves
81.	20, 21	Testing Engine Efficiency
82.	116, 94, 110, 111, 114, 120, 102	Servicing the Piston Assembly
83.	95, 109, 115, 118, 124	Servicing the Piston Cylinder
84.	104, 97	Installing Connecting Rods
85.	108, 101, 100, 121, 106, 127	Installing a Crankshaft
86.	86	Servicing the Camshaft
87.	136	Servicing the Oil Pump
88.	105	Installing the Timing Gear or Chain
89.	93, 99	Replacing the Cylinder Head
DUTY: LUBRICATING THE TRACTOR		
90.	119	Replacing the Oil Pan
91.	130, 131, 132	Inspecting the Lubricant Level on a Tractor
92.	128, 129	Changing the Crankcase Oil and Filter
93.	133	Changing Differential Lubricant
94.	135	Servicing the Oil Cooler

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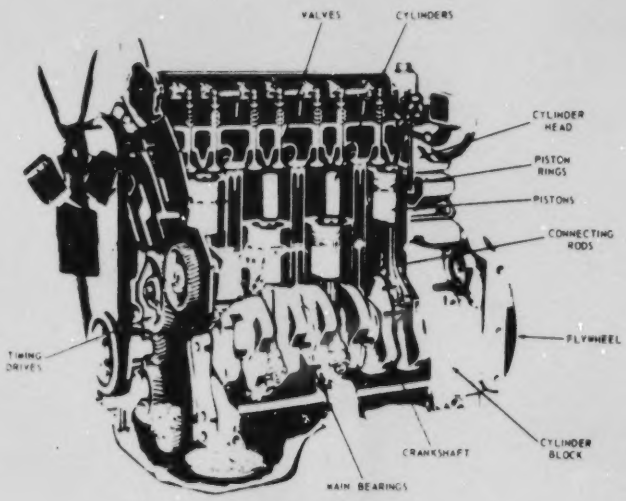
TRACTOR MECHANICS

Learning Activity Package Number	Objective Numbers	Learning Activity Package Title
DUTY: PAINTING THE TRACTOR		
95.	9	Preparing a Tractor for Painting
96.	10	Painting a Tractor

Learning Activity Package Number 78



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Servicing the Valve Assembly

Tractor Mechanics

Objective nos. 123,113,96,126

INTRODUCTION

When a tractor is brought into the shop for a complete overhaul, one of the major tasks a mechanic must perform is to grind the valves and valve seats and to replace the valve guides. Valves operate under extremely high temperatures and pressures in the engine. They are also subjected to chemical action caused by internal combustion. Since the valves operate under these extreme conditions they become pitted and lose their perfect roundness and correct angle. As a result the valves and valve seats must be ground to restore the correct angle and roundness. In this learning activity package you will learn how to properly grind valves and valve seats, how to test the valve springs, and how to replace valve guides.

DIRECTIONS

Read the objectives below. If you believe you are already able to perform these tasks, read the Check-Out Activities on page 7 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or,

If you need to complete learning activities in order to be able to do the tasks, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVES

1. Given new valve guides, a dial indicator, arbor press, and/or valve-guide puller-driver, replace the valve guides on the designated tractor. All guides needing service should be detected. Old guides must be removed without damage to the head, and new guides must be installed to specified position.

2. Given a mechanic's tool set, a valve grinding machine, lapping compound, and a tool and valve-seat refacing set, reface the valve seats until they mate perfectly with the valves.

3. Given a mechanic's tool set, a valve-spring compressor, and a valve grinding machine, grind the valves so that they mate perfectly with their seat.

(Continued)

4. Given a mechanic's tool set, the manufacturer's service manual, a valve-spring compressor, and a valve-spring tester, test the valve springs on the designated tractor. All defective springs must be replaced, and the engine will be reassembled. All springs should indicate strength as specified by the manufacturer.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (Deere & Company), Chapter 2, pp. 9-14, 21. Or, *Tractor Maintenance: Principles and Procedures* (AAVIM), pp. 45-53.

(or) _____

2 VIEW filmstrip and tape cassette "Engine Explained: How To Do A Valve Job" (Bergwall Productions, Inc.).

(or) _____

3 CHECK YOUR KNOWLEDGE of valves by taking Student Self-Check, SERVICING THE VALVE ASSEMBLY.

4 READ INSTRUCTIONS, REPLACING VALVE GUIDES; INSTRUCTIONS, GRINDING VALVE SEATS; INSTRUCTIONS, GRINDING VALVES; and INSTRUCTIONS, TESTING VALVE SPRINGS.

(or) _____

5 STUDY the section on the valve assembly in the manufacturer's service manual for the designated tractor.

(or) _____

6 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or) _____

7 PRACTICE grinding the valves and valve seats on an old engine head. Follow the procedures outlined in Learning Activity 4 and in the manufacturer's service manual.

8 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 7.

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Kit
2. Dial Indicator
3. Valve Spring Compressor
4. Arbor Press
5. Valve Grinder
6. Hand-lapping Tool
7. Valve Guide Puller-Driver
8. Valve Spring Tester

MATERIALS AND SUPPLIES NEEDED

1. Lapping Compound
2. Refacing Stones

SAFETY

Wear Appropriate Eye Protection Glasses or Goggles

INSTRUCTIONS

A. REPLACING VALVE GUIDES

In replacing valve guides, the following procedure should be used:

1. Measure "guide clearance" using a dial indicator. Determine which guides need to be replaced.

    a. With head removed and valve springs and keepers taken off, connect dial indicator to head with the pickup against the valve stem.

    b. With the valve off its seat, measure the lateral movement of the valve stem. This is valve-stem clearance. The stem and guide must be clean and dry to get an accurate measurement. Record measurement.

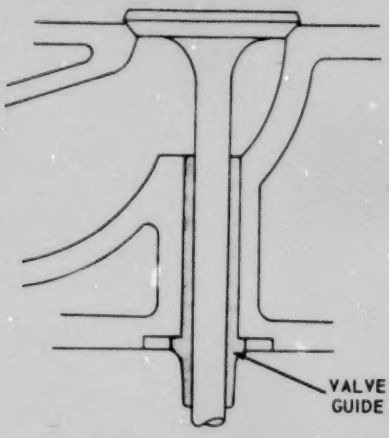

Figure 1. Valve guide.

Courtesy of John Deere and Company

2. Press out bad guides with an arbor press or pull out with an appropriate puller.

3. Drive or press new guides into place, being sure they are installed to the correct depth as specified in the manufacturer's service manual.

NOTE: Some valve guides are integral with the cylinder head and cannot be replaced. If excessively worn, they must be reamed to take an oversize valve stem and fitted with the appropriate replacement valve. Consult the manufacturer's service manual.

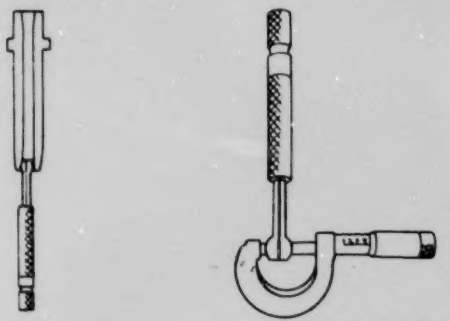

Figure 2. Measuring valve guides.

Courtesy of John Deere and Company

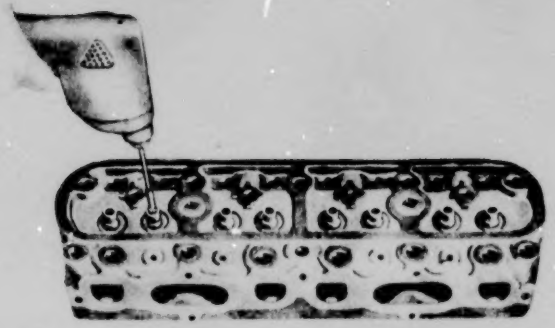

Figure 3. Cleaning valve guides.

Courtesy of John Deere and Company

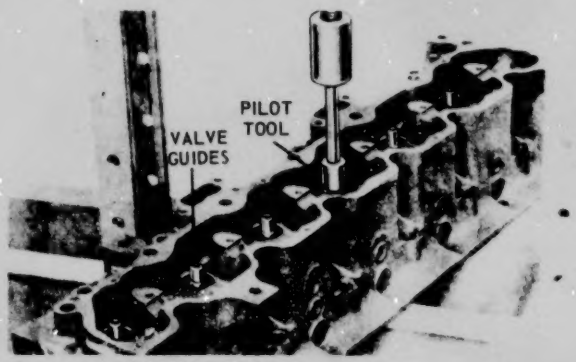

Figure 4. Installing valve guides.

Courtesy of John Deere and Company

INSTRUCTIONS

B. GRINDING VALVE SEATS

In grinding valve seats, the following procedure should be used:

1. Remove tractor parts and assemblies to make cylinder head accessible.

2. Remove cylinder head.

3. Remove valve springs and keepers with a valve-spring compressor, keeping them in order for reinstallation.

4. Check valves, stems, and guides for wear according to directions in the manufacturer's service manual.

5. Remove valves and clean them, keeping them in order.

Figure 5. Grinding valve seats.

Courtesy of John Deere and Company

6. Grind valves to specified face angle if necessary.

Figure 6. Checking concentricity of valve seat.

Courtesy of John Deere and Company

7. Select proper pilot to fit valve guide.

8. Dress refacing stone to specified angle.

9. Reface valve seats, dressing stone as necessary. Take off only enough to get a smooth seat.

10. Narrow seats if necessary, using proper stone to cut off upper surface of face.

11. Using lapping compound and a hand-lapping tool, mate each valve to its seat. Remove all traces of lapping compound.

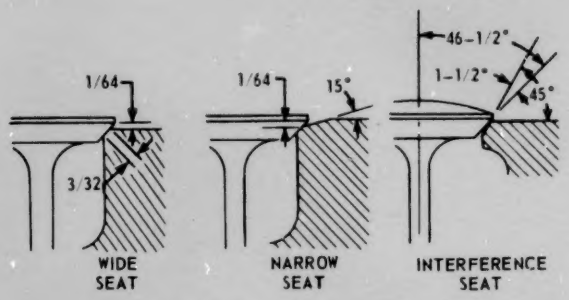

Figure 7. Typical valve seating locations.

Courtesy of John Deere and Company

12. Reinstall valves, springs, and keepers in their original places.

13. Reinstall head and adjust valves.

INSTRUCTIONS

C. GRINDING VALVES

In grinding valves, the following procedure should be used:

1. Remove tractor parts and assemblies to make cylinder head accessible. (NOTE: Watch for roto caps.)

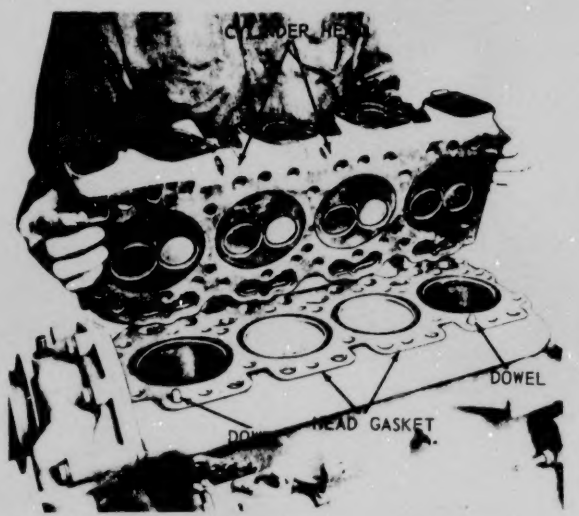

Figure 8. Removing the cylinder head.

Courtesy of John Deere and Company

2. Remove cylinder head.

3. Remove valve springs and keepers, being careful to keep all parts in order so that they can be easily reassembled.

4. Remove valves and clean them, again keeping them in order.

5. Check valve stems and guides for wear according to directions in the manufacturer's service manual. Replace if necessary.

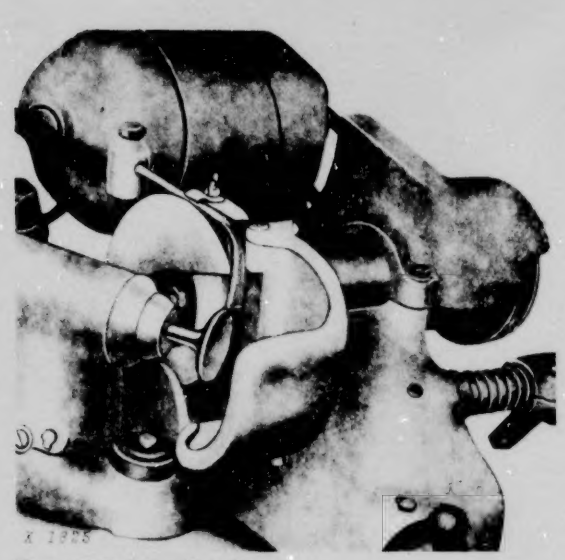

Figure 9. Refacing the valves.

Courtesy of John Deere and Company

6. Grind each valve to specified face angle. Check for adequate margin.

Figure 10. Valve head margin.

Courtesy of John Deere and Company

7. Using lapping compound and hand-lapping tool, mate each valve to its seat. Then remove all traces of lapping compound.

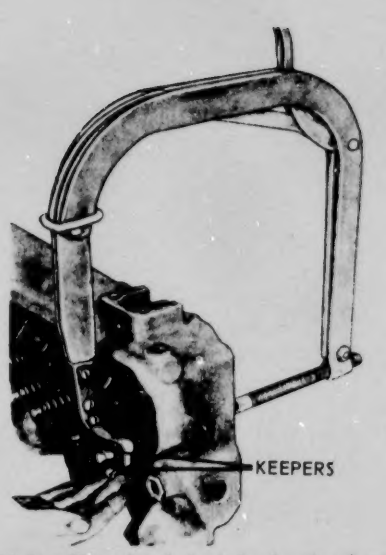

Figure 11. Installing valves (valve-in-head engine shown)

Courtesy of John Deere and Company

8. Reinstall valve springs and keepers in their original places.

9. Reinstall head and adjust valves.

INSTRUCTIONS

D. TESTING VALVE SPRINGS

In testing the valve springs the following procedure should be used:

1. Remove valve cover, head and rocker assembly.

2. Remove valves and springs; keep in order for reassembly.

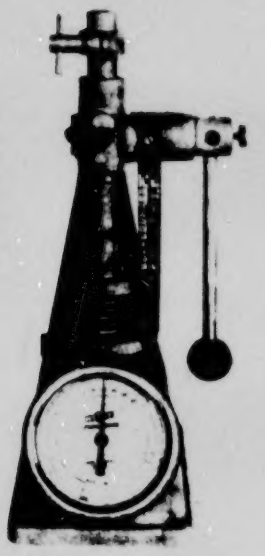

Figure 12. Checking valve spring in tester.

Courtesy of John Deere and Company

3. Using valve-spring tester and torque wrench, test each spring and then return it to its proper place.

4. Replace faulty springs.

5. Reassemble engine and adjust valves.

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
SERVICING THE VALVE ASSEMBLY

Answer the following:

1. What are the two kinds of valves?

2. What is "knurling" a valve guide?

3. What is meant by "thermal fatique"?

4. List the precautions for grinding valves:

   a.

   b.

   c.

   d.

   e.

5. What is the purpose of valve grinding?

6. What is the purpose of grinding valve seats?

7. Why should the mechanic never grasp the valve guides when handling the cylinder head?

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. Exhaust and Intake.

2. Upsetting metal on the inside wall to make the bore smaller.

3. The overheating of valves causing cracks in the valve head.

4. a) Do not grind too long
   b) Do not use too much pressure
   c) Keep work area clean
   d) Check the seat width and contact pattern
   e) Check the runout of the valve seat

5. To remove pits in the metal and to restore perfect roundness to the valve face, and to finish the valve face to its correct angle.

6. To match the finished valves.

7. You may bend or loosen the guides.

CHECK-OUT ACTIVITIES

The statements below explain the activities you must be able to complete in order to finish this learning activity package. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING THE VALVE ASSEMBLY.

On the designated tractor:

Replace the valve guides.

Reface the valve seats.

Grind the valves after removal.

Test the valve springs.

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LAP TM–78

Student _____

Date _____

SERVICING THE VALVE ASSEMBLY

Instructor's Final Checklist

Check the student's performance in the following elements of servicing the valve assembly.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	In grinding the valves, the student:				
	a. removed the cylinder head	[ ]	[ ]	[ ]	[ ]
	b. removed the valve springs and keepers	[ ]	[ ]	[ ]	[ ]
	c. removed the valves	[ ]	[ ]	[ ]	[ ]
	d. cleaned valves, guides and seats	[ ]	[ ]	[ ]	[ ]
	e. kept them in the correct order as they were taken out	[ ]	[ ]	[ ]	[ ]
	f. checked the valve stems and guides for wear	[ ]	[ ]	[ ]	[ ]
	g. ground each valve to the specified face angle	[ ]	[ ]	[ ]	[ ]
	h. checked the valves for adequate margin	[ ]	[ ]	[ ]	[ ]
2.	In grinding the valve seats, the student:				
	a. cleaned head and seats	[ ]	[ ]	[ ]	[ ]
	b. selected the proper pilot to fit the valve guide	[ ]	[ ]	[ ]	[ ]
	c. dressed the refacing stone to the specified angle	[ ]	[ ]	[ ]	[ ]
	d. refaced the valve seats	[ ]	[ ]	[ ]	[ ]

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LAP TM–78

Student _____

Date _____

SERVICING THE VALVE ASSEMBLY
(Continued)
Instructor's Final Checklist

Check the student's performance in the following elements of servicing the valve assembly.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
3. In replacing the valve guides, the student:				
a. cleaned head and valves	[ ]	[ ]	[ ]	[ ]
b. measured the valve-stem clearance	[ ]	[ ]	[ ]	[ ]
c. determined which valve stems needed repairing	[ ]	[ ]	[ ]	[ ]
d. removed the bad guides	[ ]	[ ]	[ ]	[ ]
e. replaced the worn guides with new guides	[ ]	[ ]	[ ]	[ ]
4. The replaced valve guides corresponded to the specifications in the manufacturer's service manual	[ ]	[ ]	[ ]	[ ]
5. In testing the valve springs, the student:				
a. cleaned all parts	[ ]	[ ]	[ ]	[ ]
b. kept the springs in the order in which they were taken from the head	[ ]	[ ]	[ ]	[ ]
c. checked the manufacturer's service manual for spring specifications	[ ]	[ ]	[ ]	[ ]
d. tested each spring	[ ]	[ ]	[ ]	[ ]
e. replaced faulty springs	[ ]	[ ]	[ ]	[ ]

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LAP TM–78

Student _____

Date _____

SERVICING THE VALVE ASSEMBLY
(Continued)
Instructor's Final Checklist

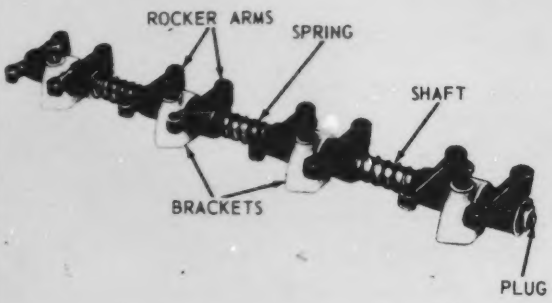
Check the student's performance in the following elements of servicing the valve assembly.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
6. After having ground the valves and the valve seats, the student:				
a. mated each valve to its seat with lapping compound	[ ]	[ ]	[ ]	[ ]
b. removed all lapping compound	[ ]	[ ]	[ ]	[ ]
c. reinstalled the valve springs and keepers in their original places	[ ]	[ ]	[ ]	[ ]
d. reinstalled the head	[ ]	[ ]	[ ]	[ ]
e. adjusted the valves	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 79



Courtesy of John Deere and Company

Replacing the Rocker Arms

Tractor Mechanics

Objective no. 122

INTRODUCTION

When overhauling an engine, a beginning mechanic may overlook the rocker arm. Measuring the rocker arm assembly for wear, checking for broken parts and making needed repairs are important tasks. Holes in the rocker arm assembly will have a tendency to gum up. When this occurs, oil cannot pass through them, causing excessive wear. In this learning activity package you will learn how to replace the rocker arm assembly.

DIRECTIONS

Before you start work on this learning activity package, be sure you have completed Learning Activity Package 78, SERVICING THE VALVE ASSEMBLY.

If you have completed this Learning Activity Package, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, go through the Learning Activities in the order given.

OBJECTIVE

Given new rocker arms, a mechanic's tool set, the manufacturer's service manual, outside micrometers, and telescoping gauges, replace the rocker arms on the designated tractor. Valves must be adjusted to specifications and all steps on the instructor's checklist will be completed.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (Deere & Company), Chapter 2, p. 22.

(or) _____

2 READ INSTRUCTIONS, REPLACING THE ROCKER ARM ASSEMBLY.

(or) _____

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3 CHECK YOUR KNOWLEDGE by taking Student Self-Check, REPLACING ROCKER ARMS.

(or) _____

4 STUDY the section on replacing rocker arms in the manufacturer's service manual for the designated tractor.

(or) _____

5 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or) _____

6 PRACTICE replacing the rocker arms on the designated tractor. Follow the procedure outlined in Learning Activity 2 and the manufacturer's service manual.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 3.

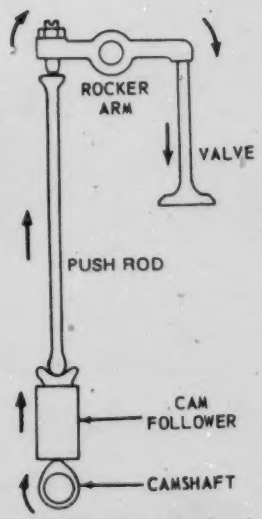


Figure 1. Valve push rod for valve-in-head engine

Courtesy of John Deere and Company

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set
2. Outside Micrometer
3. Telescoping Gauges

MATERIALS AND SUPPLIES NEEDED

1. New Rocker Arms (if required)

SAFETY

No Special Precautions

INSTRUCTIONS

REPLACING THE ROCKER ARM ASSEMBLY

In replacing rocker arms the following procedure should be used:

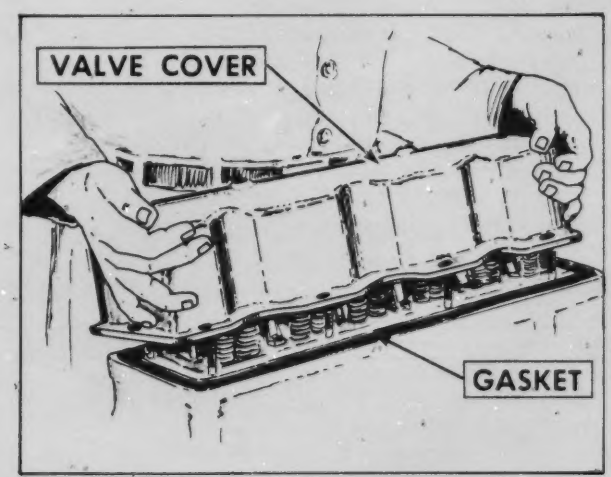


Figure 2. Remove valve cover easily to avoid damaging the gasket.

Courtesy of the American Association for Vocational Instructional Materials

1. Remove valve cover.
2. Remove rocker arm assembly.

3. Remove lock pin and slide rocker shaft out of rocker assembly, keeping other parts in order.

4. Inspect parts for wear. Use micrometer.

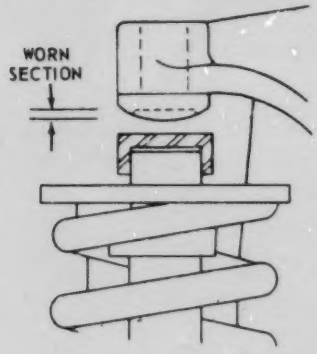


Figure 3. Worn rocker arm tip.

Courtesy of John Deere and Company

5. Reassemble on the old shaft if it is usable, or on a new shaft if necessary. Use the old parts that are usable and replace those that show excessive wear.

6. Replace assembly and adjust valves.

7. Replace valve cover.

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
REPLACING ROCKER ARMS

1. Briefly explain the function of the rocker arm.

2. What is the purpose of having holes drilled in the rocker arms? What can happen if they become plugged?

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, REPLACING THE ROCKER ARMS.

Replace the rocker arms on the designated tractor.

CORRECT RESPONSES

1. The rocker arms open the valves.

2. The drilled holes in rocker arms feed oil to the rocker arm shaft. If the holes become plugged the rocker arms and shafts may wear excessively.

DO NOT WRITE ON THIS PAGE

LAP TM–79

Student _____

Date _____

REPLACING ROCKER ARMS

Instructor's Final Checklist

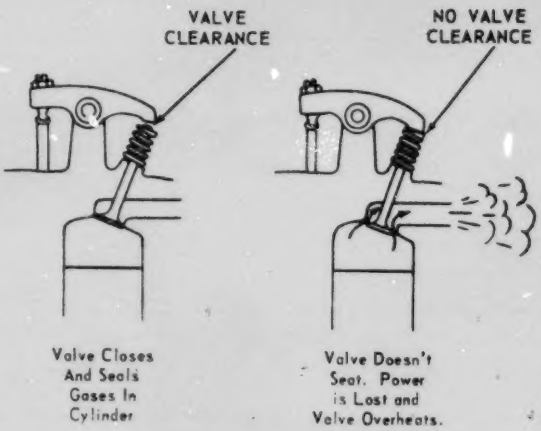
Check the student's performance in the following elements of replacing rocker arms.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
In replacing the rocker arm, the student:				
a. removed the valve cover	[ ]	[ ]	[ ]	[ ]
b. removed the rocker arm assembly	[ ]	[ ]	[ ]	[ ]
c. kept all parts in order as they were removed from the rocker arm	[ ]	[ ]	[ ]	[ ]
d. inspected the parts for wear	[ ]	[ ]	[ ]	[ ]
e. installed new parts where needed	[ ]	[ ]	[ ]	[ ]
f. replaced the assembly	[ ]	[ ]	[ ]	[ ]
g. adjusted the valves	[ ]	[ ]	[ ]	[ ]
h. replaced the valve cover	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 80


VALVE CLEARANCE
NO VALVE CLEARANCE
Valve Closes And Seals Gases In Cylinder
Valve Doesn't Seat. Power is Lost and Valve Overheats.

Courtesy of John Deere and Company

Adjusting Valves

Tractor Mechanics

INTRODUCTION

After the mechanic has serviced the valves and replaced the rocker arm assembly, clearance between the valve stem and tappets must be adjusted. The clearance must be properly adjusted to allow for the expansion of the valve stems due to extremely high temperature in the engine. If the clearance is not sufficient, the exhaust valves may be burnt due to the escaping gases. Improper clearance of the intake valves may cause the engine to backfire and lose power. In this learning activity package you will learn how to properly adjust the valves.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, go through the Learning Activities in the order given.

OBJECTIVE

Using the designated tractor, a mechanic's tool set, a tappet wrench, the manufacturer's service manual, and a crank, adjust the valve clearance. The valves should be adjusted to the manufacturer's specifications.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (Deere & Company), Chapter 2, pp. 22-23.

(or) _____

2 VIEW the slide-tape presentation, "Engine Explained: Lubrication and Valve Operation" (Bergwall Production, Inc.).

(or) _____

20

3 CHECK YOUR KNOWLEDGE of adjusting valves by taking Student Self-Check, ADJUSTING VALVES.

4 READ INSTRUCTIONS, ADJUSTING VALVES.

(or) _____

5 READ the section on adjusting valves in the manufacturer's service manual for the designated tractor.

(or) _____

6 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or) _____

7 PRACTICE adjusting the valves on the designated tractor. Follow the procedure outlined in Learning Activity 4 and the manufacturer's service manual.

8 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 4.

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set
2. Tappet Wrench
3. Feeler Gauge
4. Crank

MATERIALS AND SUPPLIES NEEDED

1. Valve Cover Gasket

SAFETY

Disconnect coil wire on gasoline engines and shut off fuel supply at the injection pump on diesel engines.

INSTRUCTIONS

A. ADJUSTING VALVES

In adjusting the valve clearance, the following procedure should be used:

1. Check the manufacturer's service manual for specifications and for engine firing order. (Some valves may be adjusted hot, while others are adjusted cold.)
2. To avoid accidental starting, disconnect the coil wire on gasoline engines and shut off the fuel supply at the injection pump on diesel engines.

Figure 1. If spark plugs are not to be removed, disconnect center terminal wire to the distributor. If spark plugs are to be cleaned, remove wire connections to plugs and position each so you can reconnect to the same plug position after cleaning. Interchanging will cause the engine to work improperly or not at all.

Courtesy of the American Association for Vocational Instructional Materials

3. Crank engine to bring number one piston to T.D.C. (top dead center) on the compression stroke.

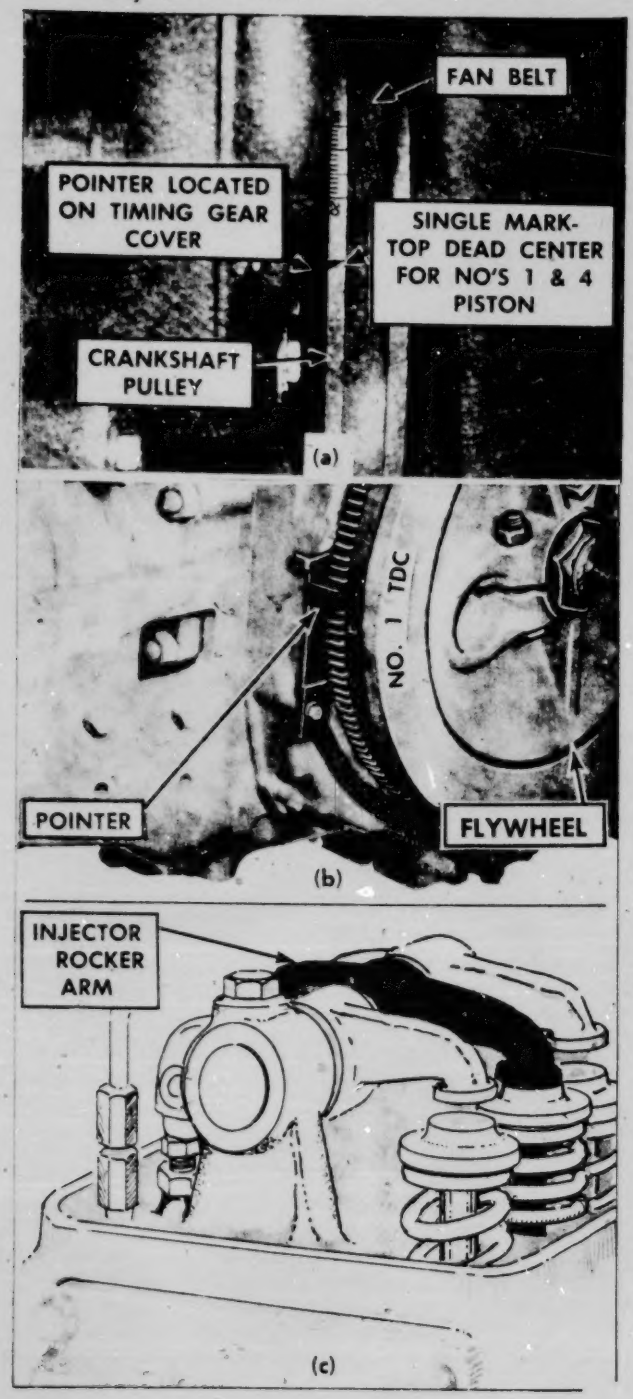


Figure 2. Some methods of determining top dead center on the No. 1 cylinder. (a) Marking on crankshaft pulley. (b) Marking on flywheel. (c) Some diesel engines have a third rocker arm that works the injector. TDC is reached when injector is fully depressed.

Courtesy of the American Association for Vocational Instructional Materials

4. Adjust both intake and exhaust valves of the number one cylinder to specifications with feeler (thickness) gauge, tappet wrench, and screwdriver. (See illustrations below)

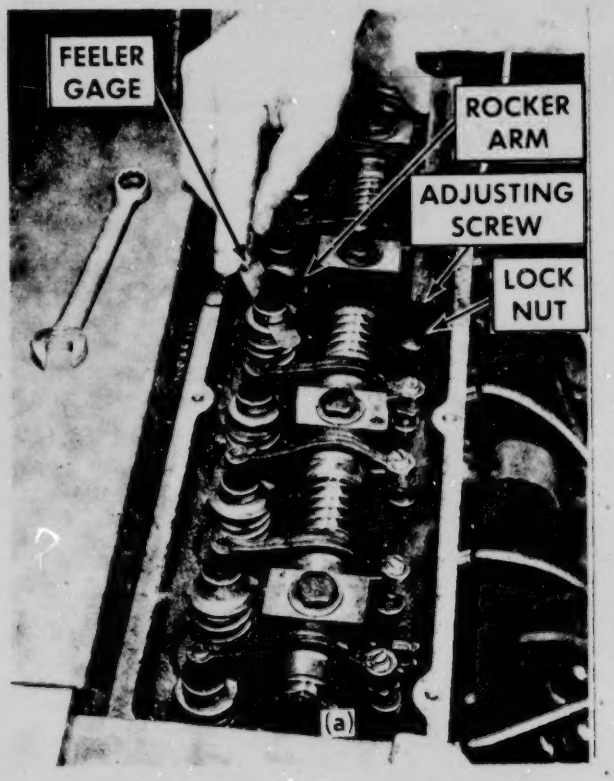


Figure 3. (a) Adjusting valve clearance on a valve-in-head engine.

Courtesy of the American Association for Vocational Instructional Materials

5. Crank engine to T.D.C. compression stroke on the next cylinder in firing order. Adjust those valves. Do the same for each succeeding cylinder in the firing order. (NOTE: Some manufacturers put number one piston on T.D.C. and adjust part of the valves, then put number six cylinder on T.D.C. and adjust the remainder of the valves. Only two positions of the crankshaft and piston are needed.)

6. Reinstall valve cover.

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
ADJUSTING VALVES

Give short answers to the following:

1. What is valve clearance adjustment?

2. Where is valve clearance adjustment made?

3. At what point is the adjustment checked?

4. What is the critical contact area in valve adjustment?

5. When you adjust the valve-tappet clearance of the number one cylinder, the piston should be on the ____ stroke.

6. How would you change the valve-tappet clearance?

7. The valve-tappet clearance will vary from ____ inch to ____ inch.

CORRECT RESPONSES

1. The clearance between the rocker arms and the ends of the valve stems when the valves are not being depressed.

2. Some are adjusted while the engine is hot, some while the engine is cold. Always check the manufacturer's service manual for the tractor.

3. Between the rocker arm and valve stem.

4. Between the valve seat and the face of the valve.

5. Compression

6. By turning the valve adjusting screw up or down until the desired clearance is obtained.

7. .006 to .030 (Check the manufacturer's service manual for the designated tractor.)

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, ADJUSTING VALVES.

Adjust the valves on the designated tractor.

DO NOT WRITE ON THIS PAGE

LAP TM–80

Student _____

Date _____

ADJUSTING VALVES

Instructor's Final Checklist

Check the student's performance in the following elements of adjusting valves.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In adjusting the valves, the student:				
a. checked the manufacturer's service manual for specifications	[ ]	[ ]	[ ]	[ ]
b. brought the number one piston to T.D.C. on the compression stroke	[ ]	[ ]	[ ]	[ ]
c. adjusted the intake and exhaust valves on the number one cylinder	[ ]	[ ]	[ ]	[ ]
d. followed the firing order in getting the cylinder on the compression stroke for the remaining cylinders	[ ]	[ ]	[ ]	[ ]
2. After being adjusted by the student, the valves exhibited no pecking	[ ]	[ ]	[ ]	[ ]
3. The engine ran smoothly	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 81

Courtesy of John Deere and Company

Testing Engine Efficiency

Tractor Mechanics

Objective nos. 20,21

INTRODUCTION

If a tractor is tuned at the proper intervals, it may reduce the "down time" for the tractor during the busy season. Before a mechanic begins to work on a tractor, he will need to make an engine diagnosis to see if an engine tune-up would solve a tractor owner's problem or if a complete overhaul is necessary. To test an engine for efficiency, the mechanic will need a dynamometer and a compression tester. In this learning activity package you will learn how to use this equipment to test engine efficiency.

DIRECTIONS

Read the objectives below. If you believe you are already able to perform these tasks, read the Check-Out Activities on page 5 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or,

If you need to complete learning activities in order to be able to do the tasks, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVES

1. Given a compression tester, a spark plug wrench, and the manufacturer's service manual, test the compression on an engine. Student readings should be within + or - 5% of the instructor's readings.

2. Given a dynamometer complete with operating instructions, the manufacturer's service manual for the tractor to be tested, and any needed tools, test the horsepower, exhaust, fuel consumption, and crankcase blow-by on the designated tractor. The dynamometer should be connected according to the manufacturer's instructions, and the student's readings must agree with those of the instructor.

LEARNING ACTIVITIES

1 READ *Fundamentals of Machine Operation: Preventive Maintenance* (John Deere Company), pp. 27 and 209-212.

(or) _____

2 VIEW filmstrip and tape cassette "Engine Tune Up: The Right Approach" (Bergwall Productions, Inc.).

(or) _____

3 READ INSTRUCTIONS, TESTING THE ENGINE EFFICIENCY, and INSTRUCTIONS, RECORDING ENGINE EFFICIENCY.

(or) _____

4 STUDY the section on testing the engine efficiency in the manufacturer's service manual for the designated tractor.

(or) _____

5 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or) _____

6 PRACTICE testing the engine compression and engine efficiency on the designated tractor. Follow the procedure outlined in Instructions A. Record the results in Instructions B.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 5.

TOOLS AND EQUIPMENT NEEDED

1. Set of Mechanic's Tools
2. Compression Tester
3. Combustion Analyzer
4. Dynamometer
5. Flow Meter
6. Manufacturer's Service Manual or I & T Shop Manual on Tractor Being Tested
7. Operator's Manual on Dynamometer Being Used
8. Nomograph
9. Nebraska Tractor Test

MATERIALS AND SUPPLIES NEEDED

1. 30W Motor Oil
2. Oil Cup or Device For Placing Oil in Cylinder

SAFETY

No Special Safety Precautions

INSTRUCTIONS

A. TESTING THE ENGINE EFFICIENCY

In testing the engine compression, the following procedure should be used:

1. Run the engine until normal operating temperature is reached.
2. Remove all spark plugs.
3. Open throttle all the way.
4. Place the gauge in one spark plug hole.
5. Crank the engine until no more rise in pressure on the gauge is apparent.
6. Record the compression reading.

Courtesy of John Deere and Company

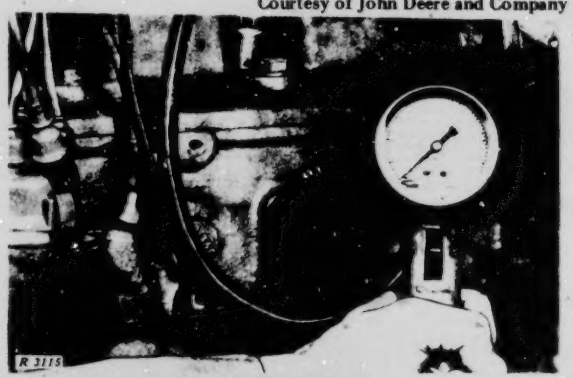


Figure 1. Checking engine compression.

7. Repeat for each spark plug hole.

8. Check specifications for compression.

9. If low pressure appears, add 1 tsp. of oil to each cylinder and repeat test. Then if compression is higher, worn rings are indicated.

10. If engine pressure obtained is 10 or more pounds below normal cylinder pressure for the tractor involved, the cause should be corrected.

In testing the engine for efficiency, the following procedure should be used:

1. Following manufacturer's instructions, connect the dynamometer to the machine.

2. Operate the engine for 30 minutes at one-half load to get coolant and crankcase oil temperatures up to normal.

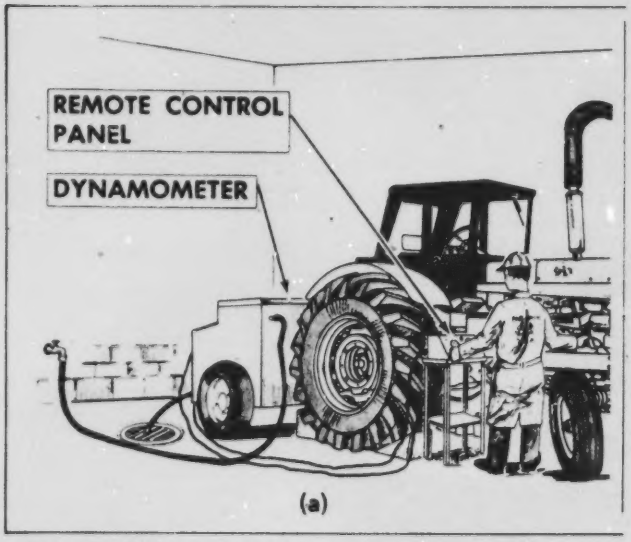


Figure 2. (a) A dynamometer that connects to the power take-off is excellent for providing a load for checking carburetor adjustments. Many dealers and some school shops have them. Follow instructions provided with dynamometer.

Courtesy of the American Association for Vocational Instructional Materials

3. Increase the load on the engine gradually until the speed is reduced to the rated load speed given in the manufacturer's service manual. Then take reading of the horsepower on the dynamometer.

4. Compare reading with that given in the service manual.

5. Following dynamometer instructions, test for: exhaust analysis, smoke analysis (diesel) and carburetor adjustment (spark ignition), and crankcase blow-by.

Note: If indicated, tune-up or overhaul the engine by following instructions in the manufacturer's service manual. Use the dynamometer after tune-up or overhaul to determine horsepower output and fuel consumption.

INSTRUCTIONS

B. RECORDING ENGINE EFFICIENCY
DO NOT WRITE ON THIS PAGE!

Complete the following:

Engine to be tested (identification no. or owner) _____

Type of vehicle _____

Make of vehicle _____

Engine hours/mileage _____

Other pertinent information _____
_____

COMPRESSION TEST

Cylinder no.	Compression Pressure Dry	With oil added	Normal
1			
2			
3			
4			
5			
6			
7			
8			

HORSEPOWER TEST

Horsepower reading of engine _____ hp
Horsepower specifications from manufacturer's service manual _____ hp

EXHAUST TEST

Observed rate of engine vapor flow _____ fps
Normal rate of vapor flow from the type of tractor tested _____ fps

SMOKE ANALYSIS (Diesel)

Observed reading _____
Standard reading _____

CARBURETOR ADJUSTMENT

Observed reading _____
Reading after adjustment _____

OBSERVED CRANKCASE BLOW-BY

Light _____
Moderate _____
Excessive _____

DIAGNOSIS: (check appropriate items)

No work needed _____
Needs tune - up _____
Needs overhaul _____
Needs work on: (specify) _____
_____
_____
_____
_____

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!

1. Why should an engine be tuned periodically?

2. List two special tools needed to test an engine for efficiency.

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. An engine should be tuned to reduce "down time" and increase efficiency.

2. (a) dynamometer
   (b) compression gauge

CHECK-OUT ACTIVITIES

The statements below explain the activities you must be able to complete in order to finish this learning activity package. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, TESTING THE ENGINE EFFICIENCY.

Test the engine compression on the designated tractor.

Test the horsepower, exhaust, fuel consumption, and crankcase blow-by on the designated tractor using the dynamometer.

DO NOT WRITE ON THIS PAGE

LAP TM–81

Student _____

Date _____

TESTING THE ENGINE EFFICIENCY

Instructor's Final Checklist

Check the student's performance in the following elements of testing the engine efficiency.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	In testing the engine's compression, the student:				
	a. brought the engine up to normal operating temperature	[ ]	[ ]	[ ]	[ ]
	b. removed all spark plugs	[ ]	[ ]	[ ]	[ ]
	c. opened the engine throttle all the way	[ ]	[ ]	[ ]	[ ]
	d. took a reading with the compression gauge	[ ]	[ ]	[ ]	[ ]
	e. recorded the compression reading	[ ]	[ ]	[ ]	[ ]
	f. checked each cylinder for compression	[ ]	[ ]	[ ]	[ ]
	g. checked specifications for compression	[ ]	[ ]	[ ]	[ ]
	h. added 1 tsp. of oil to each cylinder if low pressure appeared, and repeated the test	[ ]	[ ]	[ ]	[ ]
2.	In testing the horsepower, the student:				
	a. properly connected the dynamometer to the tractor	[ ]	[ ]	[ ]	[ ]
	b. brought the engine up to normal operating temperature	[ ]	[ ]	[ ]	[ ]
	c. took a reading at the rated load speed as given in the manufacturer's service manual	[ ]	[ ]	[ ]	[ ]

DO NOT WRITE ON THIS PAGE

LAP TM–81

Student _____

Date _____

TESTING THE ENGINE EFFICIENCY
(Continued)

Instructor's Final Checklist

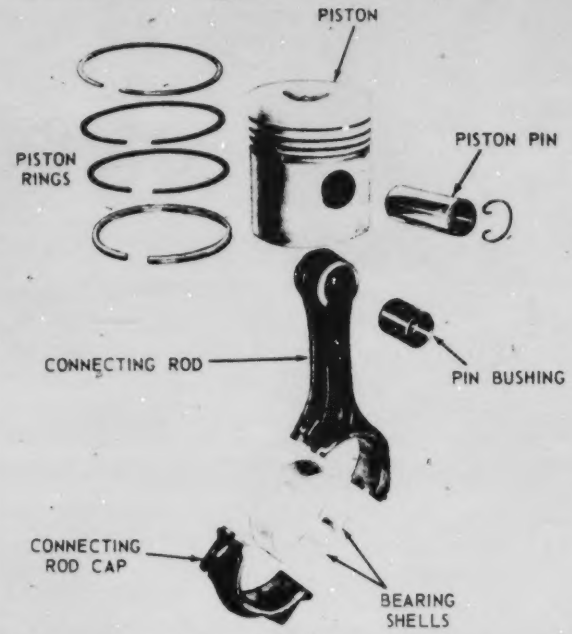
Check the student's performance in the following elements of testing the engine efficiency.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
d. compared the dynamometer reading to the reading given in the manufacturer's service manual	[ ]	[ ]	[ ]	[ ]
3. In running the dynamometer test, the student followed the manufacturer's instructions in testing for:				
a. exhaust analysis	[ ]	[ ]	[ ]	[ ]
b. smoke analysis (diesel)	[ ]	[ ]	[ ]	[ ]
c. carburetor adjustment (gasoline engine)	[ ]	[ ]	[ ]	[ ]
d. crankcase blow-by	[ ]	[ ]	[ ]	[ ]
4. From the test the student decided either to tune-up or to overhaul the engine	[ ]	[ ]	[ ]	[ ]
5. The student's decision agreed with that of the instructor	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 82



Courtesy of John Deere and Company

Servicing the Piston Assembly

Tractor Mechanics

Objective nos. 116,94,110,111,114,120,102

INTRODUCTION

When a tractor comes into the shop for an overhaul, servicing the piston assembly will be a major task the mechanic will perform. In any engine, the piston receives the force of combustion in the cylinder and transmits this force to the crankshaft. The piston rings, which seal and wipe the cylinder, are critical to securing the compression which is necessary for proper operation. In this learning activity package you will learn to remove, clean, measure, and replace rings in this piston assembly, and install the piston assembly back into the tractor.

DIRECTIONS

Before you begin work on this learning activity package, be sure you have completed Learning Activity Package 81, TESTING THE ENGINE EFFICIENCY.

If you have completed this Learning Activity Package, read the objectives below. If you feel you are already able to perform these tasks, read the Check-Out Activities on page 6 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or,

If you need to complete learning activities in order to be able to do the tasks, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVES

1. Given a mechanic's tool set, a parts-cleaning tank and a soft-faced hammer, remove and clean the piston assembly and clean the cylinder block and oil passages on a tractor. The piston must be removed without damage to the piston or any other part on the engine. All parts of the cylinder block, oil passages, and piston will be clean and there must be no significant damage to any parts.

2. Given a piston ring and feeler gauge, measure the piston-ring end gap and land clearance on the designated tractor. Measurements should agree with those of the instructor.

(Continued)

3. Given a mechanic's tool set, a ring-groove cleaner or an old ring, a ring expander, a ridge reamer, and a ring compressor, remove the carbon from the ring grooves and replace old piston rings. The piston must be clean and unscratched. All steps on the Instructor's Final Checklist must be completed during the replacement process.

4. Given a mechanic's tool set and a piston ring compressor, install a piston assembly in the designated tractor. The piston must be installed without any damage to any part of the engine.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (John Deere Company), Chapter 2, pp. 30-43.

(or) _____

2 READ INSTRUCTIONS A, REMOVING AND CLEANING THE PISTON ASSEMBLY AND CYLINDERS; INSTRUCTIONS B, MEASURING THE PISTON RING END GAP AND PISTON RING LAND CLEARANCE; and INSTRUCTIONS C, REPLACING PISTON RINGS AND INSTALLING THE PISTON ASSEMBLY.

(or) _____

3 CHECK YOUR KNOWLEDGE of the piston assembly by doing Student Self-Check, SERVICING THE PISTON ASSEMBLY.

4 STUDY the section on servicing the piston assembly in the manufacturer's service manual for the designated tractor.

(or) _____

5 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or) _____

6 PRACTICE removing, cleaning, measuring and replacing rings in the piston assembly and installing the piston assembly back into the tractor. Follow the procedure outlined on INSTRUCTIONS A, B, AND C.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 6.

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set
2. Parts Cleaning Tank
3. Feeler Gauge
4. Ring Groove Cleaner
5. Ring Expander
6. Ridge Reamer
7. Piston Ring Compressor

MATERIALS AND SUPPLIES NEEDED

1. New Piston Rings

SAFETY

Make sure engine block is secure. If chain hoist is used, wear safety goggles.

INSTRUCTIONS

A. REMOVING AND CLEANING THE PISTON ASSEMBLY AND CYLINDER

In removing a piston assembly, the following procedure should be used:

1. With head and oil pan removed and cylinder reamed, loosen rod cap bolts or nuts.

2. Check piston and rod for identifying marks. If they are not already marked, mark each piston, rod, and cap with cylinder number and direction of placement.

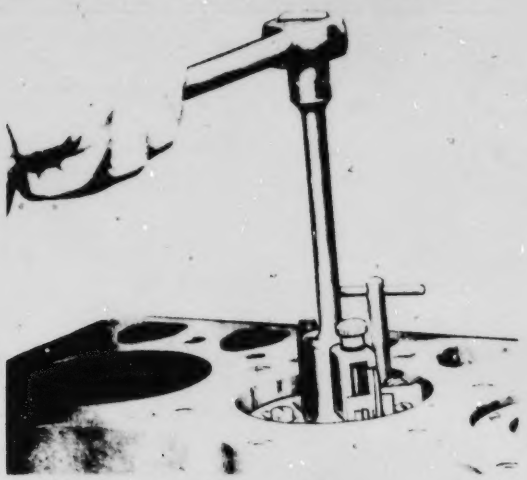


Figure 1. Removing ridge from cylinder.
Courtesy of John Deere and Company

3. Tap rod cap loose with a soft-faced hammer, if necessary.

4. Remove rod cap bolts (or nuts) and push piston out of cylinder.

In cleaning the cylinder block, oil passages, and piston, the following procedure should be used:

1. Wear safety equipment.

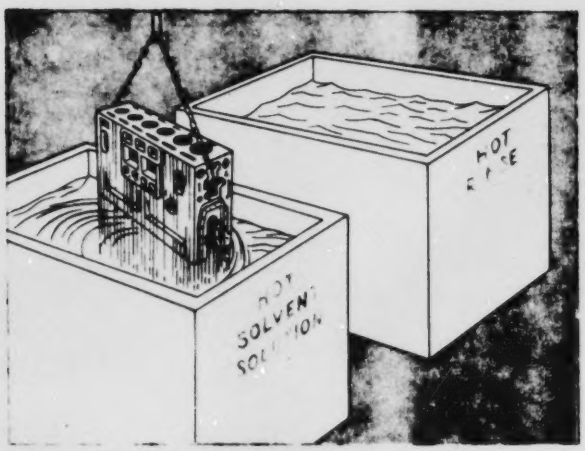


Figure 2. Cleaning the cylinder block (cast-iron type)
Courtesy of John Deere and Company

2. With engine completely disassembled, wash all mechanical parts in parts-cleaning tank.

3. Scrape and brush dirt and carbon deposits from block, head, pistons, etc., being careful not to remove any metal from the parts being cleaned.

4. Blow out all oil passages with compressed air and blowgun. Any blocked passages must be cleared with a wire or other tool and then blown out.

In removing the carbon from the ring grooves, the following procedure should be used:

1. Remove piston from engine.

Figure 3. Removing piston rings.
Courtesy of John Deere and Company

2. Remove rings from piston.

3. Select proper cutter on ring groove cleaning tool and place tool on piston. Turn tool around piston to clean groove.

4. If groove cleaning tool with correct cutter is not available, a piece of an old ring makes a fair substitute.

5. Be careful not to remove any metal from the piston. Removal of any metal will affect ring side clearance.

B. MEASURING THE PISTON RING END GAP AND PISTON RING BAND CLEARANCE

In measuring the piston ring end gap, the following procedure should be used:

1. With piston removed, carefully compress a ring and insert it in the cylinder.
2. Be sure the ring is lined up in the cylinder by tapping it down about one inch with the top of an inverted piston.

Figure 4. Measuring ring clearance with a feeler gauge.
Courtesy of John Deere and Company

3. Measure the gap between the ends of the ring with a feeler gauge, and record reading.
4. Take readings at one inch intervals down to the lowest point of ring travel. The smallest reading is the ring end gap.

In measuring the piston ring band clearance, the following procedure should be used:

1. With piston cleaned and carbon removed, place the edge of the ring in the groove in which the ring will run.
2. Hold feeler gauge in groove beside the ring, and measure clearance between the ring and the side of the groove.
3. Rotate piston and check measurement around total circumference. Record measurement.

INSTRUCTIONS

C. REPLACING PISTON RINGS AND INSTALLING THE PISTON ASSEMBLY

In replacing piston rings the following procedure should be used:

1. Remove the head.
2. Remove the oil pan.
3. Ream the ridge.
4. Remove piston.
5. Remove old rings.
6. Clean piston.
7. Using ring expander, install new rings being careful not to scratch the piston. Place rings on piston as shown on the instructions that come with the rings. Note the end gap arrangement.
8. Install piston.

While installing the piston assembly the following procedure should be used:

1. With rings installed on piston and lightly oiled, rod installed in piston, and cylinder honed and cleaned, tighten ring compressor on piston and rings.
2. Place piston in cylinder, being sure the correct side faces front and the rod correctly fits on the crankshaft.
3. Tap piston down into cylinder with a block of soft wood or soft-faced hammer, watching to see that the rod seats correctly on the crankshaft.
4. Install bearing inserts and rod caps.

DO NOT WRITE ON THIS PAGE!

SERVICING THE PISTON ASSEMBLY

Complete the following:

1. When removing piston rings, the mechanic should replace only the damaged ones. (T or F)

2. Why should the mechanic mark the position of each connecting rod and piston when removing them from the engine?

3. What are the functions of the compression rings?

4. What is the function of the oil control ring?

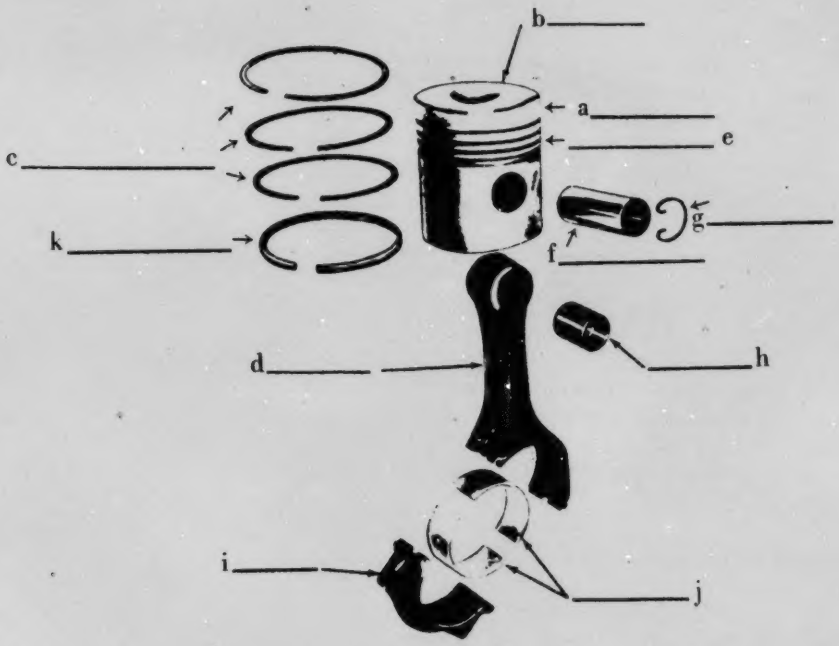
5 List five causes of oil consumption and blow-by due to piston assembly.

a
b
c
d
e

6. After the piston has been cleaned you should examine the piston for_____.

7. Why should you thoroughly lubricate the piston and rings prior to installation?

8. Label the following diagram.



Courtesy of John Deere and Company

CHECK-OUT ACTIVITIES

The statements below explain the activities you must be able to complete in order to finish this learning activity package. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING THE PISTON ASSEMBLY.

Using the designated tractor:

Remove and clean the piston assembly, and clean the cylinder block, oil passages, and piston.

Measure a piston-ring end gap and band clearance.

Remove the carbon from the piston ring grooves and replace the piston rings.

Install a piston assembly.

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CORRECT RESPONSES

8. a. Top band
   b. Piston
   c. Compression ring
   d. Connecting rod
   e. Ring grooves
   f. Piston pin
   g. Pin retainer
   h. Pin bushing
   i. Connecting rod cap
   j. Bearing shells
   k. Oil ring

7. Several revolutions may be necessary in a dry engine before the lubrication system supplies oil to all moving parts.

6. Score marks, damaged ring grooves, signs of overheating

5. a. Piston rings installed wrong
   b. Stuck rings or plugged oil ring
   c. Top ring broken or groove worn
   d. Overall wear in piston, rings, and cylinder:
      1. Abrasive wear
      2. Scuffing and scouring
      3. Corrosive wear
   e. Physical damage to piston

4. To wipe the excess oil from the cylinder wall.

3. They seal by expanding out against the cylinder wall to prevent gases from leaking by the piston during the compression and power stroke.

2. To be sure they are installed in the same cylinder. This gives a better fit since the parts are already "wear fitted" to their own cylinders.

1. False; Replace all rings regardless of the condition

DO NOT WRITE ON THIS PAGE

LAP TM–82

Student _____

Date _____

SERVICING THE PISTON ASSEMBLY

Instructor's Final Checklist

Check the student's performance in the following elements of servicing the piston assembly.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	In removing the piston assembly the student:				
	a. marked each piston, rod, and rod cap with cylinder number (if not already marked)	[ ]	[ ]	[ ]	[ ]
	b. marked the piston assembly for direction of placement	[ ]	[ ]	[ ]	[ ]
	c. tapped rod caps loose with a soft-faced hammer	[ ]	[ ]	[ ]	[ ]
	d. removed piston assembly without damage	[ ]	[ ]	[ ]	[ ]
2.	The cylinder block, oil passages, and piston contained no grease, dirt, carbon or rust deposits after being cleaned by the student	[ ]	[ ]	[ ]	[ ]
3.	In measuring the piston-ring end gap the student:				
	a. compressed and inserted a ring into the cylinder	[ ]	[ ]	[ ]	[ ]
	b. took readings with a feeler gauge at each one inch interval until the lowest point was reached in which the ring would travel	[ ]	[ ]	[ ]	[ ]
4.	The piston-ring end gap measurement agreed with that of the instructor	[ ]	[ ]	[ ]	[ ]
5.	Measurement of the piston-ring band clearance agreed with the instructor's reading	[ ]	[ ]	[ ]	[ ]
6.	The cleaned piston contained no carbon or scratches in the ring grooves	[ ]	[ ]	[ ]	[ ]

DO NOT WRITE ON THIS PAGE

LAP TM–82

Student _____

Date _____

SERVICING THE PISTON ASSEMBLY

(Continued)
Instructor's Final Checklist

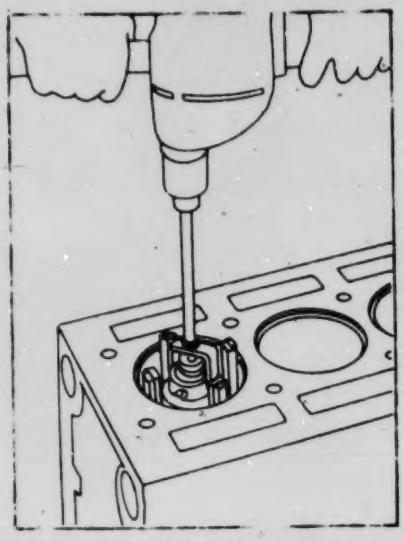
Check the student's performance in the following elements of servicing the piston assembly.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
7. The student replaced the rings on the piston without breaking any rings	[ ]	[ ]	[ ]	[ ]
8. While installing the piston assembly back into the shop tractor the student:				
a. lightly oiled the piston rings	[ ]	[ ]	[ ]	[ ]
b. tightened the ring compressor on the piston and rings	[ ]	[ ]	[ ]	[ ]
c. tapped the piston down into the cylinder with a block of soft wood or soft-faced hammer	[ ]	[ ]	[ ]	[ ]
d. installed the piston assembly back into the block with the correct side to the front and the rod sealed on the crankshaft	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 83



Honing the cylinder bore

Courtesy of John Deere and Company

Servicing the Piston Cylinder

Tractor Mechanics

Objective nos. 95,109,115,118,124

INTRODUCTION

One of the tasks a mechanic will perform when overhauling an engine is to service the cylinder block. Most cylinders today have individual castings called liners or sleeves. The liners will be either (1) a dry sleeve or (2) a wet sleeve. The sleeves will wear along with the piston rings and will need to be replaced over a period of time. In this learning activity package you will learn how to service the cylinder.

DIRECTIONS

Before you begin to work on this learning activity package, be sure you have completed the learning activity package No. 82, "Servicing the Piston Assembly."

If you have completed this Learning Activity Package, read the objectives below. If you feel you are already able to perform these tasks, read the Check-Out Activities on page 6 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or,

If you need to complete learning activities in order to be able to do the tasks, turn to p. 2 and go through the Learning Activities in the order given.

OBJECTIVES

(1) Given a cylinder and a feeler gauge, measure the cylinder taper. The readings and computations should agree with those of the instructor.

(2) Given a mechanic's tool set and a ridge reamer, remove a cylinder ridge from the piston cylinder. The ridge will be cut enough to allow the piston to be removed, but not deeper than the ring wear mark.

(3) Given a cylinder and a cylinder hone, deglaze a cylinder. The honing must be adequate to remove most glaze (small, isolated spots of glaze are sometimes necessary to prevent over-honing). No abrasive should be allowed to come in contact with the crank shaft.

(Continued)

(4) Given a mechanic's tool set and a sleeve puller, replace dry sleeves. The old sleeves must be removed without damage to the block; the block must be thoroughly cleaned and the new sleeves must be fully seated.

(5) Given new sleeves, service manual, lubricants, seals, and the necessary tools and checking equipment, replace the wet sleeves on a designated engine. Disassembly and reassembly must follow the manufacturer's instructions. The out-of-roundness must be within manufacturer's specifications. The cylinder must not leak, and there must be no damage to any parts.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (Deere & Company), Chapter 2, pp. 25-30.

(or) _____

2 READ INSTRUCTIONS A, SERVICING THE CYLINDER and INSTRUCTIONS B, REPLACING SLEEVES.

(or) _____

3 CHECK YOUR KNOWLEDGE of servicing piston cylinders by taking Student Self-Check, SERVICING THE CYLINDER.

4 STUDY the section on cylinders in the manufacturer's service manual for the designated tractor.

(or) _____

5 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or) _____

6 PRACTICE performing the servicing of the cylinder on an old discarded engine. Follow the procedure outlined in Learning Activity 2 and in the manufacturer's service manual.

7 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activities on page 6.

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set
2. Feeler Gauge
3. Cylinder Ridge Reamer
4. Cylinder Hone
5. Sleeve Puller and Appropriate Shoe for Tractor Being Used
6. I & T Shop Manual on Designated Tractor

MATERIALS AND SUPPLIES NEEDED

1. 30W Oil for Lubricating Hone
2. Soap Base Lubricant for "0" Rings
3. Seal for Sleeves
4. New Sleeves

SAFETY

Do not remove cylinder hone from cylinder before stopping the hone.

INSTRUCTIONS

A SERVICING THE CYLINDER

In measuring the cylinder taper, the following procedure should be used:

1. With piston removed, carefully compress a ring and insert it in the cylinder.
2. Be sure the ring is lined up in the cylinder by tapping it down about one inch with the top of an inverted piston.

Courtesy of John Deere and Company

Figure 1. Measuring cylinder bore.

3. Measure the gap between the ends of the ring with a feeler gauge and record reading. (Cylinder bore gauge or telescoping micrometer may be used.)

4. Take readings at one inch intervals down to the lowest point of ring travel.

5. The differences between the largest and smallest readings divided by 3.1416 gives the cylinder taper.

In removing the ridge groove from the cylinder, the following procedure should be used:

1. With cylinder head removed, crank engine to place piston at bottom of stroke.

2. Install ridge reamer in top of cylinder.

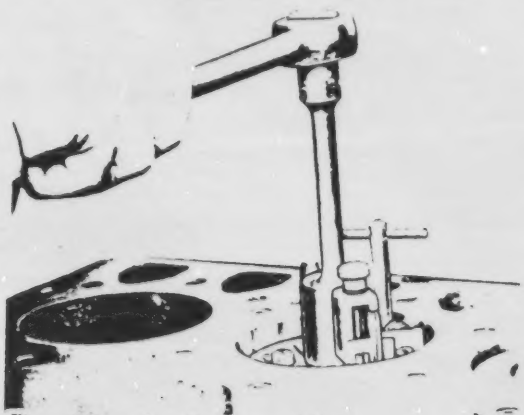


Figure 2 Removing ridge from cylinder.
Courtesy of John Deere and Company

3. Turn ridge reamer with a ratchet. (Turn it only in the direction in which it cuts. Turning backwards will damage the cutter.)

4. Keep enough tension on cutter to cut a small shaving, but not enough to cause it to "dig in."

5. Ream slowly and inspect the ridge often. Stop as soon as the ridge is cut sufficiently to allow the piston to be removed. (Any remaining ridge will be removed when the cylinder is honed.)

6. Clean out cylinder carefully before moving piston. (An oily rag placed on top of piston will catch metal and carbon shavings.)

In deglazing a cylinder, the following procedure should be used:

1. With pistons removed, cover the crankshaft with clean cloths (if shaft is still in engine).

2. Adjust cylinder hone (glaze breakers) to fit cylinder and attach to electric drill.

Figure 3. Cylinder liner deglazing tool.
Courtesy of John Deere and Company

3. Oil hone lightly throughout honing process.

4. Hone should be moved up and down in the cylinder to produce a cross-hatch pattern which helps piston ring break-in. Operate drill at 400 RPM or less.

5. Progress should be checked often to guard against over-honing.

6. When honing is completed, cylinders should be scrubbed clean with hot water and detergent to remove all abrasive particles and then oiled lightly to prevent rust.

INSTRUCTIONS

B. REPLACING SLEEVES

In replacing dry sleeves, the following procedure should be used:

1. Remove grease or cosmoline from new sleeve. "MIC" to insure proper size.

2. Put new sleeves in freezer. (This shrinks them for easier installation.)

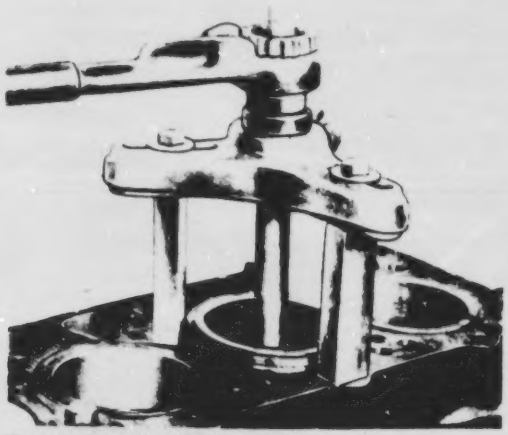


Figure 4. Removing cylinder liner.

3. With cylinder head and pistons removed, put sleeve puller in place over one cylinder.

4. Make sure puller disc bears only on the sleeve and does not contact cylinder block.

5. Turn puller only with hand tools and remove old sleeve. (Do not use an impact wrench.)

6. Remove other sleeves in the same way.

7. Clean out cylinder holes in block.

8. Remove new sleeves from freezer and insert them quickly into their places. If they do not seat freely, they must be tapped into place quickly with a soft-faced hammer before they warm up and swell into the block.

In replacing wet sleeves, the following procedure should be used:

1. Read manufacturer's service manual for instructions for removing all parts necessary to reach the cylinder sleeve. Details of removal will vary with size and type of engine.

2. Use screw-threaded or impact pullers to remove sleeve. (In stubborn cases other aids must be used, and it may be necessary to use inhibited acid compounds to remove scales from the water jacket to free sleeve. Penetrating oil, solvents, or heat may help.)

3. With sleeve removed, clean the lower sealing ring surface in the block to prevent coolant leakage past the sealing rings.

4. Measure the cylinder bore for taper and out-of-roundness. Rebore and hone if necessary. Clean thoroughly.

5. Clean all deposits from under the flange of sleeve and mating bore in block. (Sleeve must rest flat to prevent distortion.)

6. Check sleeve bore in block, and if flange surface is uneven, remachine it.

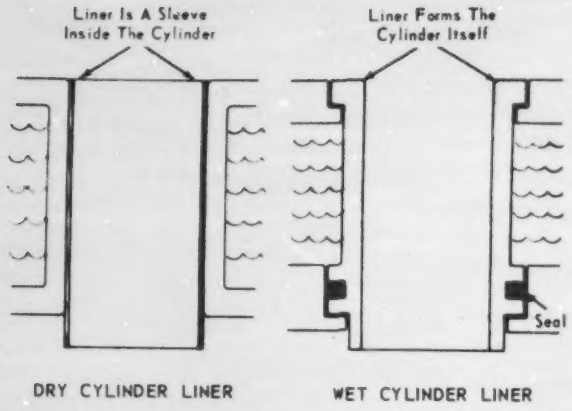


Figure 5. Types of cylinder liners.

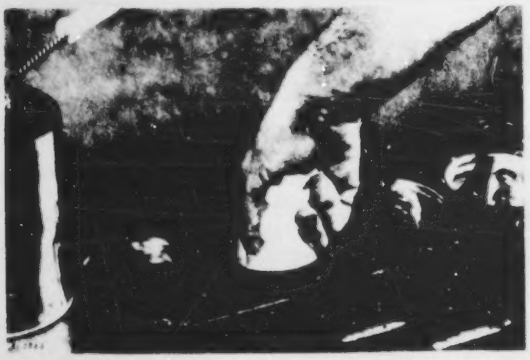


Figure 6. Thoroughly clean cylinders after honing or deglazing.

7. Clean the lower sealing surfaces in block and sleeve to prevent coolant leaks when sleeve is installed. Wet sleeves – a small round brush extended and used with a 1/4 inch drill is good for removing material in grooves.

8. Install new sleeve without seals and check to make sure the sleeve is seated squarely by measuring the height at several places. Compare the height to engine specifications and machine the block or add shims if necessary. Note: Not all sleeves require shims – check shop manual.

9. Remove sleeve and put new seals on sleeve. Lubricate the seal and the mating surfaces in the block with material recommended by manufacturer. Note: Not all sealing rings fit on sleeves. Some go into block. A lubricating material with a soap base is available that makes installation and sealing easier.

10. Work sleeve into place (by hand) as far as possible. Finish seating the sleeve by placing a wood block over it and hammering gently. Note: Make sure sealing ring does not twist in block. Breakage will occur if this happens.

Figure 7. Deglazing hone pattern

11. Check for correct liner installation by measuring the out-of-roundness in the liner bore. If it is distorted, check for twisted seals or deposits on the liner bore seats.

12. Following instructions in the manufacturer's service manual, reassemble all parts.

13. If sleeve is not tight after reassembly, a thicker sleeve (outside diameter), will have to be obtained.

STUDENT SELF-CHECK

Answer the following:

1. You should turn the ridge reamer only in the direction in which it cuts. (True or False)

2. When honing a cylinder, you should never move the hone up and down in the cylinder to produce a cross-hatch pattern. (True or False)

3. Placing dry sleeves in a freezer will help shrink them for easier installation. (True or False)

4. Cleanliness is very important and necessary when working on the piston assembly. (True or False)

5. Why should cylinders be deglazed?

6. What instrument would you use to measure the gap between the ends of the ring when checking the rings?

7. What is cylinder taper?

8. When installing dry sleeves it is very important to make certain the new seals fit against the block and sleeve so coolant will not leak when the sleeve is installed. (True or False)

Compare your answers with the correct responses at the bottom of the page. Review any incorrect answers before going on to the next Learning Activity.

CHECK-OUT ACTIVITIES LAP 83

The statements below explain the activities you must be able to complete in order to finish this learning activity package. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING THE PISTON CYLINDER.

On the designated tractor:

Measure a cylinder taper.

Remove a cylinder ridge from the piston cylinder.

Deglaze a cylinder.

Replace the dry sleeves.

Replace the wet sleeves on an assigned engine.

CORRECT RESPONSES

1. True. Turning backwards will damage the cutter.
2. False. The cross-hatch pattern helps in piston ring break-in.
3. True
4. True
5. To provide cavities for holding oil during piston ring break-in.
6. Feeler gauge
7. The difference between the largest reading of the ring gap in the cylinder and the smallest reading divided by 3.1416.
8. False. This process is important when installing wet sleeves. The coolant leaking into the dry sleeve is no problem since the coolant is contained inside the block.

DO NOT WRITE ON THIS PAGE

LAP TM–83

Student _____

Date _____

SERVICING THE PISTON CYLINDER

Instructor's Final Checklist

Check the student's performance in the following elements of servicing the piston cylinder.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	In measuring the cylinder taper, the student:				
	a. inserted a compressed ring into the cylinder by tapping it down one inch from the top with an inverted piston	[ ]	[ ]	[ ]	[ ]
	b. took readings of end gap at inch intervals down to the lowest point of ring travel	[ ]	[ ]	[ ]	[ ]
	c. got a final reading which agreed with the instructor's	[ ]	[ ]	[ ]	[ ]
2.	In removing the cylinder ridge, the student:				
	a. turned the reamer slowly in the direction it cuts	[ ]	[ ]	[ ]	[ ]
	b. stopped reaming when the ridge was cut enough to remove the piston	[ ]	[ ]	[ ]	[ ]
	c. cleaned the cylinder before removing the piston from the cylinder	[ ]	[ ]	[ ]	[ ]
3.	In deglazing a cylinder, the student:				
	a. covered the crankshaft with a clean cloth (if the shaft was still in the engine)	[ ]	[ ]	[ ]	[ ]
	b. oiled the cylinder hone lightly throughout process	[ ]	[ ]	[ ]	[ ]
	c. moved the hone up and down in the cylinder at 400 RPM or less during the process	[ ]	[ ]	[ ]	[ ]

DO NOT WRITE ON THIS PAGE

LAP TM–83

Student _____

Date _____

SERVICING THE PISTON CYLINDER
(Continued)
Instructor's Final Checklist

Check the student's performance in the following elements of servicing the piston cylinder.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
d.	checked work often to guard against overhoning	[ ]	[ ]	[ ]	[ ]
e.	washed cylinder with detergent and hot water to remove all abrasive particles; then oiled cylinder lightly	[ ]	[ ]	[ ]	[ ]
4.	In replacing dry sleeves, the student:				
a.	removed grease or cosmoline from the new sleeve	[ ]	[ ]	[ ]	[ ]
b.	used a "mic" to insure proper size	[ ]	[ ]	[ ]	[ ]
c.	shrank new sleeve by placing it in a freezer	[ ]	[ ]	[ ]	[ ]
d.	turned the puller with hand tools when removing the sleeves	[ ]	[ ]	[ ]	[ ]
e.	cleaned cylinder holes in the block	[ ]	[ ]	[ ]	[ ]
f.	removed new sleeves from the freezer and inserted them quickly into place	[ ]	[ ]	[ ]	[ ]
g.	tapped the sleeve into place lightly with a soft-faced hammer	[ ]	[ ]	[ ]	[ ]
5.	In replacing wet sleeves, the student:				
a.	pulled the sleeve	[ ]	[ ]	[ ]	[ ]
b.	cleaned the lower sealing ring surface in the block	[ ]	[ ]	[ ]	[ ]

DO NOT WRITE ON THIS PAGE

LAP TM–83

Student _____

Date _____

SERVICING THE PISTON CYLINDER

(Continued)

Instructor's Final Checklist

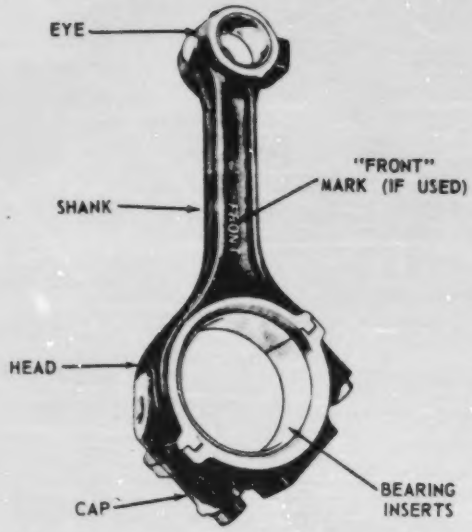
Check the student's performance in the following elements of servicing the piston cylinder.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
c.	measured the cylinder bore for taper and out-of-roundness and rebored and honed if necessary	[ ]	[ ]	[ ]	[ ]
d.	cleaned deposits from under the flange of sleeve and mating bore in the block and cleaned the lower sealing surfaces in the block	[ ]	[ ]	[ ]	[ ]
e.	installed a new sleeve without seals to check height at several places (to be certain sleeves were seated squarely)	[ ]	[ ]	[ ]	[ ]
f.	removed the sleeve and put new seals on the sleeve	[ ]	[ ]	[ ]	[ ]
g.	lubricated the seal and mating surfaces in the block	[ ]	[ ]	[ ]	[ ]
h.	placed the sleeve securely in the block	[ ]	[ ]	[ ]	[ ]
i.	checked for correct liner installation by measuring the out-of-roundness in the liner bore	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 84



Courtesy of John Deere and Company

Installing Connecting Rods

Tractor Mechanics

Objective nos. 104,97

INTRODUCTION

While the mechanic has an engine broken down, he should always replace the rod bearings. The connecting rods operate at high speeds with high temperatures and other stress conditions which result in wear and damage. Misaligned rods can cause oil consumption and blow-by; they also impose extra loads on the rod bearings, the piston and cylinder walls. In this learning activity package you will learn how to replace rod bearings and inserts.

DIRECTIONS

Read the objectives below. If you believe you are already able to perform these tasks, read the Check-Out Activities on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or,

If you need to complete learning activities in order to be able to do the tasks, go through the Learning Activities in the order given.

OBJECTIVES

1. Given a complete mechanic's tool set, the manufacturer's service manual, micrometers, plastigage, and a soft-faced hammer, install rod bearings on the designated tractor. The rod bearings must be properly seated, all bearings must be torqued and clearance checked as specified by the service manual.

2. Given a manufacturer's service manual, micrometers, plastigage, and a soft- faced hammer, install connecting rod caps on the designated tractor. The bearing must be properly seated as specified in the service manual.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (John Deere Company), Chapter 2, pp. 46-48.

(or) _____

19

2 READ INSTRUCTIONS, INSTALLING CONNECTING RODS AND ROD CAPS.

(or) _____

3 STUDY the section on connecting rods and caps in the manufacturer's service manual for the designated tractor. Be sure to make a note of the torque specifications.

(or) _____

4 CHECK YOUR KNOWLEDGE of connecting rods by taking Student Self-Check, INSTALLING CONNECTING RODS.

5 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or) _____

6 PRACTICE installing the connecting rods and caps on an old engine. Follow the procedure outlined in Learning Activity 2 and in the manufacturer's service manual.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 4.

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set
2. I & T Shop Manual
3. Torque Wrench
4. Soft Face Hammer

MATERIALS AND SUPPLIES NEEDED

1. Plastigage
2. Light Oil
3. New Bearings

SAFETY

Make Certain the Engine Block is Secured.

A. INSTALLING CONNECTING RODS & ROD CAPS

When installing rod bearings, the following procedure should be used:

1. Remove all parts necessary to make piston and crankshaft accessible.
2. Unbolt rod cap.
3. Jar cap loose from rod with a soft-faced hammer.
4. Remove cap, noting its position for reassembly. Mark them if not marked. Note: Make marks toward cam shaft side.
5. Push rod away from crankshaft, taking care not to scratch crankshaft journal.
6. "Mic" journal for excess wear. (If piston is to be removed for ring placement etc., now is the time.)

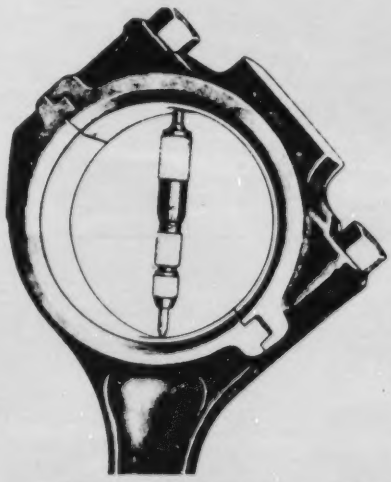


Figure 1. Measuring connecting rod bearing clearance.

Courtesy of John Deere and Company

7. Pry insert from rod and rod cap.
8. Remove rod bearings and install new rod bearings.
9. Install new inserts in the same position.

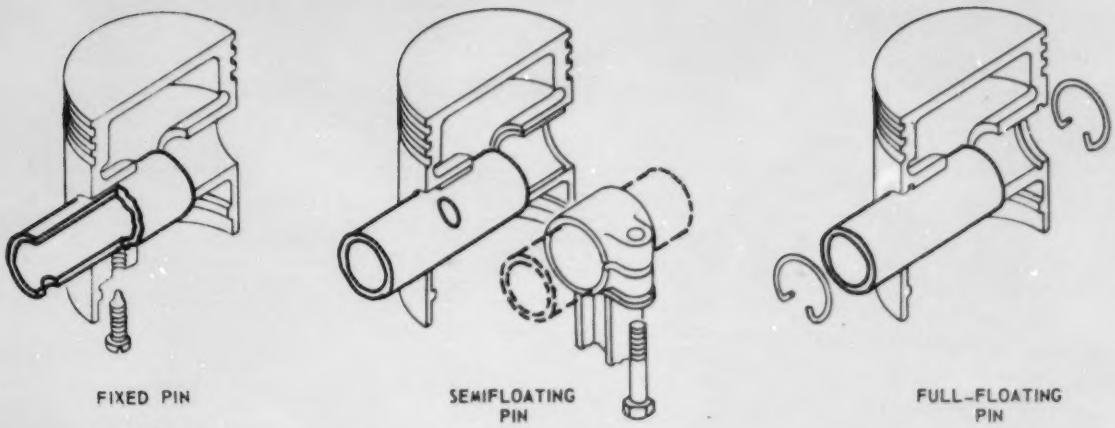


Figure 2. Piston pins - Three ways of fastening.

Courtesy of John Deere and Company

10. Oil bearings lightly with engine oil. Note: Oil with a lubricant that will stick to bearing until engine oil starts circulating well.

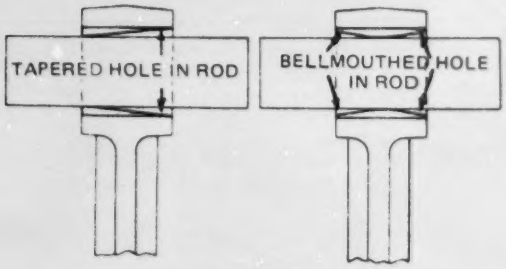


Figure 3. Bad pin fits in connecting rod.

Courtesy of John Deere and Company

11. Reseat rod on crankshaft journal. Do not scratch crankshaft.

12. Reinstall rod cap.

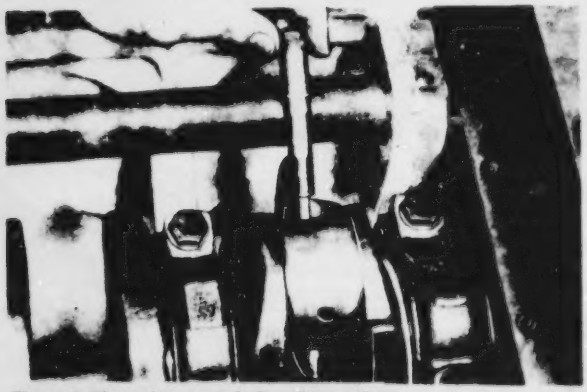


Figure 4. Measuring crankshaft rod journals.

Courtesy of John Deere and Company

13. Torque to specifications (to seat inserts).

Courtesy of John Deere and Company

Figure 5. Placing plastigage on bearing insert.

14. Remove cap and place a strip of "plastigage" across the insert.

15. Replace cap and torque to specifications.

Figure 6. Determining bearing clearance with plastigage.

Courtesy of John Deere and Company

16. Remove cap and measure plastigage width using card that comes with plastigage.

17. If clearance is within specified limits, clean plastigage from insert and journal. Lubricate, install, and torque rod cap.

18. Bend up lock tabs or install lock wires as required.

19. Reassemble engine.

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
INSTALLING CONNECTING RODS

Answer the following:

1. Why should the position of each connecting rod and piston be marked before removing them from the engine?

2. Rods that are misaligned can cause:
   a.
   b.
   c.

3. Bearing clearance can be measured with the crankshaft in place by using_____.

4. A torque wrench is not needed when installing connecting rods. (T or F)

5. A soft-faced hammer should not be used to jar the caps loose from the rods. (T or F)

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CORRECT RESPONSES

1. To be certain they are installed back into the same cylinder. This gives a better fit since the parts are already "wear fitted" to their own cylinder.
2. a) oil consumption
   b) blow-by
   c) impose big loads on the rod bearings, the pistons and cylinder walls
3. Plastigage
4. False
5. False

CHECK-OUT ACTIVITIES

The statements below explain the activities you must be able to complete in order to finish this learning activity package. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, INSTALLING CONNECTING RODS.

On the designated tractor:

Install rod bearings.

Install connecting rod caps.

DO NOT WRITE ON THIS PAGE

LAP TM–84

Student _____

Date _____

INSTALLING CONNECTING RODS

Instructor's Final Checklist

Check the student's performance in the following elements of installing connecting rods.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	When installing rod bearings, the student:				
a.	unbolted the rod caps	[ ]	[ ]	[ ]	[ ]
b.	removed the caps, noting their position for reassembly	[ ]	[ ]	[ ]	[ ]
c.	pushed the rods away from the crankshaft	[ ]	[ ]	[ ]	[ ]
d.	"Miked" the crankshaft journals for excessive wear	[ ]	[ ]	[ ]	[ ]
e.	pried the inserts from the rods and rod caps	[ ]	[ ]	[ ]	[ ]
f.	removed rod bearings and installed new rod bearings	[ ]	[ ]	[ ]	[ ]
g.	installed new inserts	[ ]	[ ]	[ ]	[ ]
h.	reseated the rods on the crankshaft journal	[ ]	[ ]	[ ]	[ ]
i.	reinstalled the rod caps	[ ]	[ ]	[ ]	[ ]
j.	torqued to specifications	[ ]	[ ]	[ ]	[ ]
k.	removed the caps and placed a strip of "plastigage" across the inserts	[ ]	[ ]	[ ]	[ ]
l.	replaced the caps and torqued to specifications	[ ]	[ ]	[ ]	[ ]
m.	removed the cap and measured the plastigage width	[ ]	[ ]	[ ]	[ ]

DO NOT WRITE ON THIS PAGE

LAP TM–84

Student _____

Date _____

INSTALLING CONNECTING RODS
(Continued)
Instructor's Final Checklist

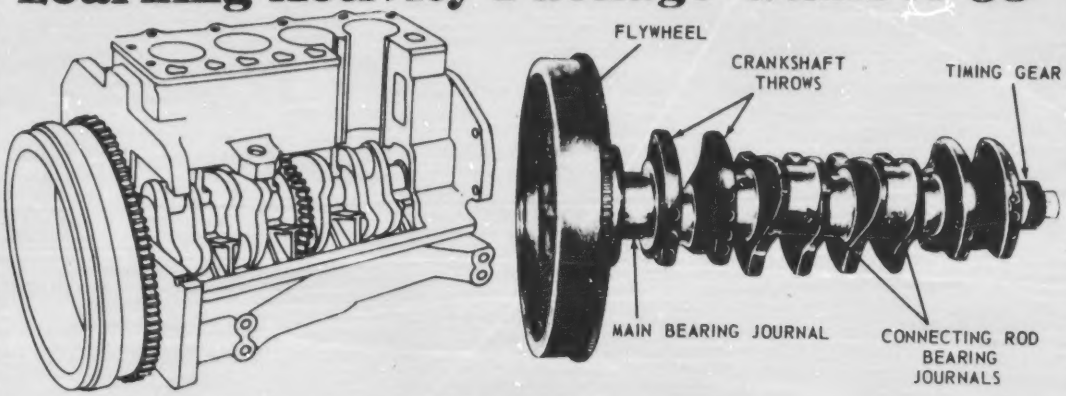
Check the student's performance in the following elements of installing connecting rods.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
n.	cleaned the plastigage from the inserts and journals	[ ]	[ ]	[ ]	[ ]
o.	lubricated, installed, and torqued the rod caps	[ ]	[ ]	[ ]	[ ]
p.	bent up lock tabs or installed the lock wires as required	[ ]	[ ]	[ ]	[ ]
2.	The bearing was seated according to specifications	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 85



Installing a Crankshaft

Tractor Mechanics

Courtesy of John Deere and Company

Objective nos. 108,101,100,121,106,127

INTRODUCTION

While a mechanic is doing the overhaul job he should always install new main bearing inserts and oil seals, and check the crankshaft journals for wear. As the crankshaft main bearings and oil seals become worn, the engine will not maintain adequate oil pressure. When an engine is pulling a load, loose main bearings produce a definite knock. If the main bearings are not kept tight, it could finally cause an engine to throw a rod. In this learning activity package you will learn how to properly install a crankshaft and make necessary adjustments.

DIRECTIONS

Read the objectives below. If you believe you are already able to perform these tasks, read the Check-Out Activities on page 6 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or,

If you need to complete learning activities in order to be able to do the tasks, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVES

1. Given a service manual, micrometer, and a mechanic's tool set, measure and record the crankshaft main and rod journals. Recorder measurements should be the same as those of the instructor.

2. Given bearings and caps, a mechanic's tool set, service manual, and engine oil, install main bearings and caps on the designated tractor. All main cap bolts should be torqued and clearances measured to manufacturer's specifications.

3. Given a mechanic's tool set and a seal driver, install front oil seal. The seal must be fully installed in a clean bore and correctly fitted around crankshaft. All parts must be reinstalled in good order with no leaks present.

(Continued)

4. Given a mechanic's tool set, a torque wrench, a new gasket, and a seal, install rear engine oil seal. The new seal must be correctly placed and must hold oil. All parts will be correctly placed and tightened.

5. Given a mechanic's tool set, micrometers, plastigage, and a soft-faced hammer, measure the bearing clearance. The measurement must agree with the instructor's measurement.

6. Using the designated tractor and service manual and a mechanic's tool set, torque the main bearings on the tractor. All main bearings must be within torque specifications.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (John Deere Company), Chapter 2, pp. 48-54, or *I & T Shop Manual on Tractor Being Used.*

2 READ INSTRUCTIONS A, MEASURING CRANKSHAFT WEAR; INSTRUCTIONS B, INSTALLING CRANKSHAFT, MAIN BEARING AND CAPS; and INSTRUCTIONS C, INSTALLING SEALS.

(or) _____

3 CHECK YOUR KNOWLEDGE of crankshafts by doing Student Self-Check, REPAIRING AND INSTALLING CRANKSHAFTS.

4 STUDY the section on crankshafts in the manufacturer's service manual for the designated tractor. Be sure to make a note of the torque specifications, or study the I & T Shop Manual on Tractor Being Used.

5 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or) _____

6 PRACTICE installing the crankshaft and seals in an old engine. Follow the procedure outlined in Instruction Sheets A, B, and C, and in the manufacturer's service manual.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 6.

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set
2. Seal Driver
3. Outside Micrometer
4. Soft-Face Hammer
5. I & T Shop Manual on Tractor
6. Torque Wrench
7. Seal Puller

MATERIALS AND SUPPLIES NEEDED

1. Plastigage for Bearings
2. Appropriate Seals for Front and Rear
3. Gaskets
4. Bearings
5. Gasket Sealer
6. Light Weight Engine Oil

SAFETY

The engine block is very heavy. Make sure it is secured before servicing.

INSTRUCTIONS

A. MEASURING CRANKSHAFT WEAR

When measuring the crankshaft main and rod journals, the following procedure should be used:

1. With crankshaft removed, clean and visually inspect for obvious damage.

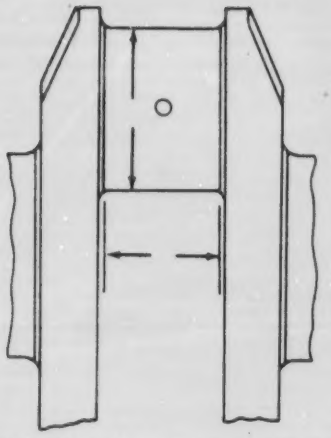


Figure 1. Crankshaft dimensions to be measured before regrinding.

Courtesy of John Deere and Company

2. Using outside micrometer, make and record three measurements for each bearing journal, one in the middle and one near each end of the journal.

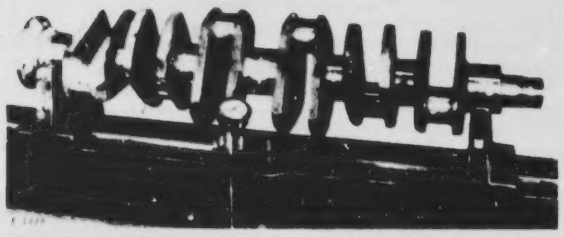


Figure 2. Checking crankshaft alignment with a dial indicator.

Courtesy of John Deere and Company

3. Compare your measurements with specifications for the crankshaft.

Figure 3. Measuring crankshaft journals with a micrometer.

Courtesy of John Deere and Company

4. Any significant variation between the three measurements on any one journal indicates uneven wear. Record variations. Tolerance should be within .002 - .004 inches (.0508 - .1016 mm) of standard or to what it has been ground.

5. Now make a decision whether crankshaft is usable or whether it needs repair work.

INSTRUCTIONS

B. INSTALLING CRANKSHAFT, MAIN BEARINGS AND CAPS

When installing a crankshaft, main bearings and caps, the following procedure should be used:

1. Remove old crankshaft. Mark parts for proper assembly. In marking parts, take center punch and mark main caps and connecting rod to the crankshaft side of engine. Place a mark on the cap and one to correspond to it on the block. Beginning at the radiator end, number 1, 2, 3, etc. Number rod caps in same manner.

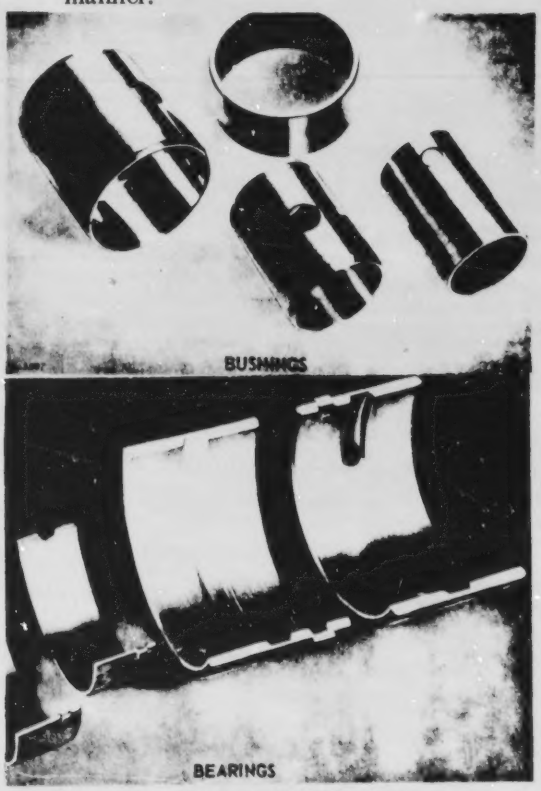


Figure 4. Bushings and bearings for typical engine.

Courtesy of John Deere and Company

2. New bearings should be used on a new or re-ground crankshaft. Replace both main and rod bearings.

3. Install inserts in block and caps, making sure that the insert with holes in it goes in the block and lines up with hole or oil gallery. Use soft-face hammer to tap in place.

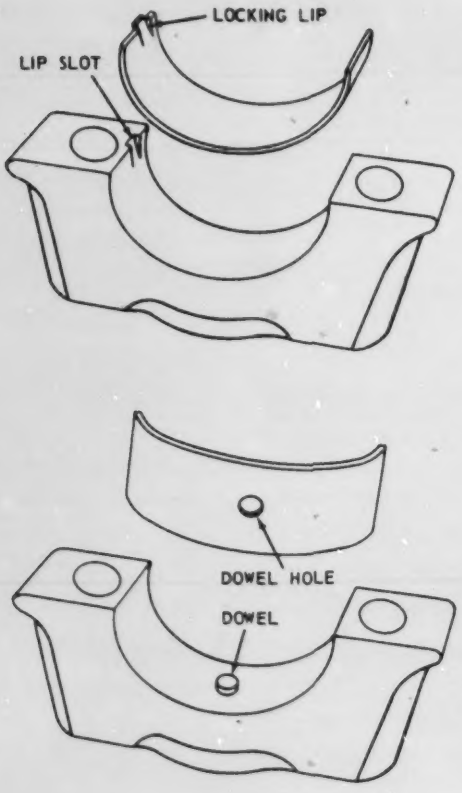


Figure 5. Types of bearing locks.
Courtesy of John Deere and Company

4. Lubricate insert on main caps with light engine oil. This will provide ample lubrication until oil pump starts functioning.

5. Put crankshaft in place and install main caps, being sure caps are on the correct bearings and turned the right way. If you failed to mark cap, another check can be used. Notice the slot in each insert. They should be on the same side when properly installed.

6. Torque all main cap bolts.

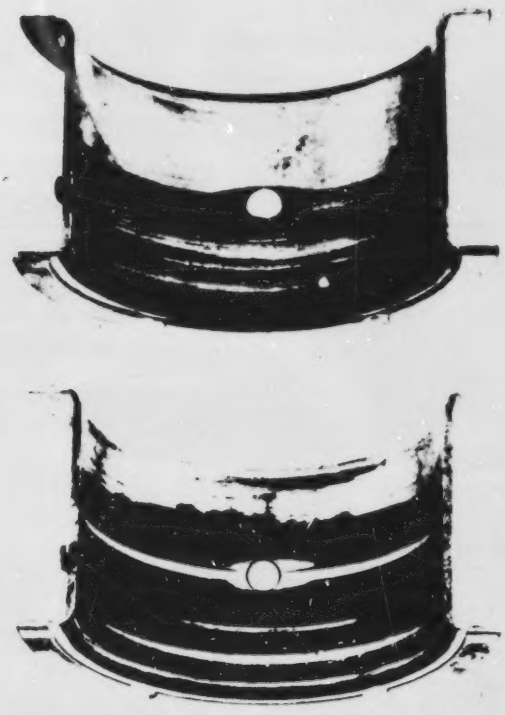


Figure 6. Wear on one edge of bearing caused by tapered journals.
Courtesy of John Deere and Company

Figure 7. Placing plastigage on bearing insert.
Courtesy of John Deere and Company

7. Remove front main cap and place a strip of plastigage across the full width of the insert.

8. Install and torque cap.

9. Remove cap and measure plastigage (at front, center, and back of insert).

10. If clearance is not to specification, correct it with over or undersized inserts and check again.

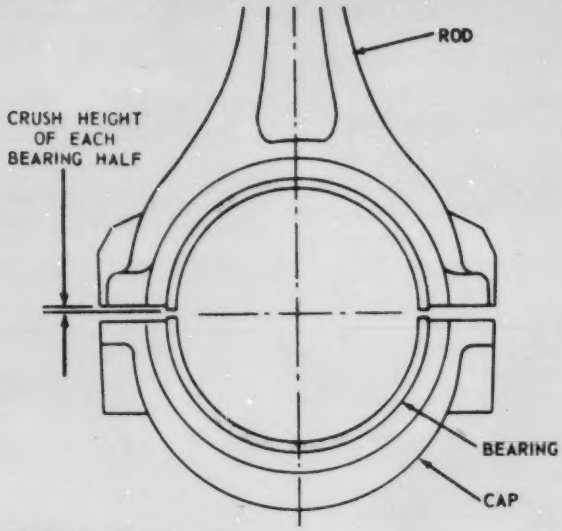


Figure 8. Bearing crush allowance.
Courtesy of John Deere and Company

11. When clearance is correct, clean plastigage off insert and journal and replace and torque the cap.

12. Do the same for additional main bearings.

INSTRUCTIONS

C. INSTALLING SEALS

1. After removing other parts as necessary, remove timing gear (or timing chain cover.)

2. Using a cape chisel or seal puller, remove old seal from timing cover and clean seal bore.

3. Apply light coat of appropriate sealing compound to outer surface of new seal. Before seal is installed, make sure seal is turned correctly.

4. Drive seal in place with correct size seal installer, being sure the seal seats fully.

5. Lubricate seal with engine oil.

6. Reinstall timing cover with appropriate gasket, sealant, etc., being very careful not to damage the seal as it fits over end of crankshaft.

7. Torque timing cover bolts to specifications.

8. Reinstall other parts removed in step number 1.

When installing the rear main oil seals and rear engine seal, the following procedure should be used:

1. Remove oil pan and clean.

2. Remove all traces of oil pan gasket from block.

3. Remove rear main bearing cap.

4. Loosen other main bearings to allow crankshaft to drop slightly.

5. Pull out old seal.

Rear main seals are of two types.

1. A circular neoprene seal with a metal housing similar to the front.

2. A felt seal in two halves.

If number 1 is used, install like the front seal. If number 2 is used, the following procedure should be used:

1. Take two halves of felt seal and soak in oil for at least 30 minutes.

2. After soaking seals in oil, take each half and place into seal retainer using a screwdriver to pack all the felt into each half of the retainer. There appears to be some excess. DO NOT CUT OFF. All felt needs to be packed into retainer to properly insure that the seal functions properly.

3. Install gasket on seal retainer and replace on block.

4. Torque main bearings.

5. Reinstall oil pan with new gasket and sealing compound.

CHECK-OUT ACTIVITIES

The statements below explain the activities you must be able to complete in order to finish this module. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, INSTALLING A CRANKSHAFT.

On the designated tractor:

Measure and record the crankshaft main and rod journals.

Install a crankshaft, main bearings and caps.

Install front and rear main oil seals.

Measure the bearing clearance.

Torque the main bearings.

STUDENT SELF-CHECK

DO NOT WRITE ON THIS PAGE!

PREPARING AND INSTALLING THE CRANKSHAFT

Answer the following:

1. Why is the crankshaft so heavy?

2. Where should you take micrometer readings on the bearing journals?

3. What reading does plastigage give you?

4. When torquing the main bearing, the bolts should be tightened in sequence by ____ foot pound increments.

5. If one of the crankshaft main journals is defective, the complete crankshaft should be replaced. (T or F)

6. If it is determined that one main bearing insert needs replacing, there is no need to replace the other bearing insert. (T or F)

7. The crankshaft should have no endplay after it is installed into the block. (T or F)

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CORRECT RESPONSES

1. Because of the heavy throws that are used as counterweights to balance the engine during rotation.
2. You should make three measurements for each bearing journal – one in the middle and one near each end of the journal.
3. It will give the bearing clearance.
4. Five
5. True: the crankshaft is one piece.
6. False: if one main bearing insert needs replacing, always replace both bearing inserts.
7. False: the crankshaft must have a certain amount of endplay to get the proper thrust during operation and to avoid excessive wobble and wear.

DO NOT WRITE ON THIS PAGE

LAP TM–85

Student _____

Date _____

INSTALLING A CRANKSHAFT

Instructor's Final Checklist

Check the student's performance in the following elements of installing a crankshaft.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	In preparing to install the crankshaft, the student:				
	a. visually inspected the crankshaft for damage	[ ]	[ ]	[ ]	[ ]
	b. made and recorded three measurements for each bearing journal	[ ]	[ ]	[ ]	[ ]
	c. compared measurements with the specifications for the crankshaft	[ ]	[ ]	[ ]	[ ]
	d. recorded the measurements	[ ]	[ ]	[ ]	[ ]
2.	When installing the crankshaft, main bearings and caps, the student:				
	a. installed the main bearing inserts and main cap inserts	[ ]	[ ]	[ ]	[ ]
	b. installed and torqued the main caps	[ ]	[ ]	[ ]	[ ]
	c. checked the main bearing clearance with plastigage	[ ]	[ ]	[ ]	[ ]
3.	When installing the front oil seals, the student:				
	a. cleaned the seal bore	[ ]	[ ]	[ ]	[ ]
	b. applied sealing compound to the outer surface of the seal and installed the seal	[ ]	[ ]	[ ]	[ ]
	c. reinstalled and torqued the timing cover to specifications	[ ]	[ ]	[ ]	[ ]

DO NOT WRITE ON THIS PAGE

LAP TM–85

Student _____

Date _____

INSTALLING A CRANKSHAFT
(Continued)
Instructor's Final Checklist

Check the student's performance in the following elements of installing a crankshaft.

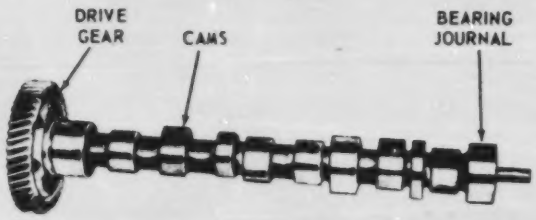
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
4. When installing the rear main oil seals, the student:				
a. carefully removed parts to secure access	[ ]	[ ]	[ ]	[ ]
b. pulled out the old seals	[ ]	[ ]	[ ]	[ ]
c. properly lubricated the new seals	[ ]	[ ]	[ ]	[ ]
d. installed and torqued the rear main cap with seal	[ ]	[ ]	[ ]	[ ]
5. The student measured the bearing clearances with plastigage	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 86

SERVICING THE CAMSHAFT



Courtesy of John Deere and Company

Tractor Mechanics

Objective no. 86

INTRODUCTION

When reconditioning an engine, the mechanic should always check the camshaft. The lobes on the camshaft produce an important service to the engine. They must raise the valves one by one at the proper time. They operate under pressure by rapidly moving the tappets, push rods, and rocker arms at high speeds. As a result of this high speed, wear will occur causing the lobes to fail to raise the valves high enough to let fuel and air enter or exhaust gases to escape. In this learning activity package you will learn how to properly service the camshaft.

DIRECTIONS

Read the objectives below. If you believe you are already able to perform these tasks, read the Check-Out Activities on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or,

If you need to complete learning activities in order to be able to perform these tasks, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVES

1. Given a complete mechanic's tool set, the manufacturer's service manual, and a micrometer, measure the camshaft for wear. All variations from the specifications will be determined.

2. Using the designated tractor, a new set of camshaft bearings, the manufacturer's service manual for the designated tractor, a micrometer for measuring parts to specifications and the necessary tools and lubricants, replace the camshaft bearings. Disassembly and reassembly should be in the order recommended in the service manual and the new bearings must be the same size as those replaced. All parts must be to manufacturer's specifications and there must be no damage to any parts.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (John Deere Company), Chapter 2, pp. 17-19.
(or) _____

2 READ INSTRUCTIONS, SERVICING CAMSHAFTS.

(or) _____

3 STUDY the section on servicing camshafts in the manufacturer's service manual for the designated tractor.

(or) _____

4 CHECK YOUR KNOWLEDGE of camshafts by taking Student Self-Check, SERVICING CAMSHAFTS.

5 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or) _____

6 PRACTICE servicing the camshaft on the designated tractor. Follow the procedure outlined in Learning Activity 2 and the manufacturer's service manual.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 4.

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Kit
2. Outside Micrometer
3. Service Manual

MATERIALS AND SUPPLIES NEEDED

1. Lubricants
2. New Camshaft Bearing

SAFETY

Make Sure Engine Block Is Secured

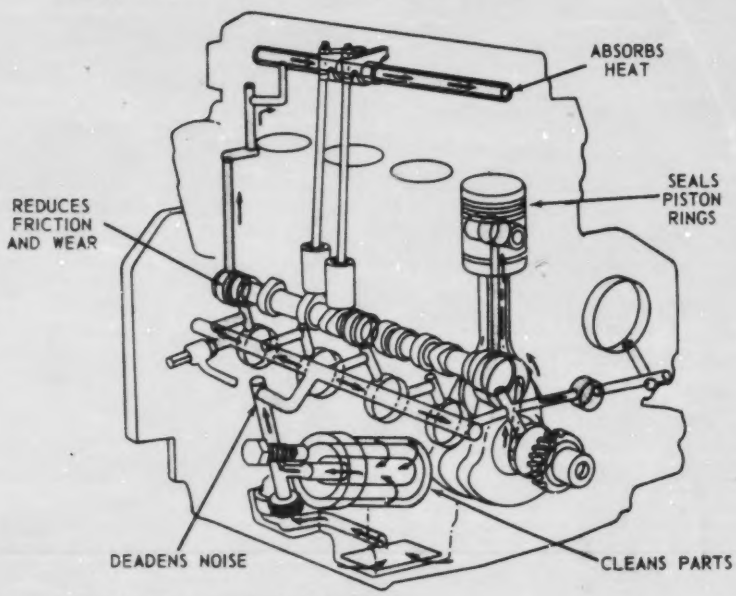


Figure 1. Lubrication system for typical engine.
Courtesy of John Deere and Company

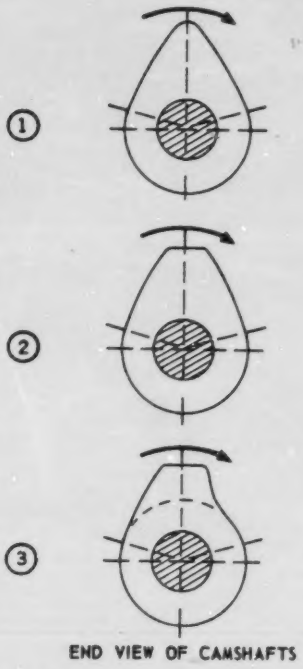


Figure 2. Cam profiles.
Courtesy of John Deere and Company

SERVICING THE CAMSHAFT

1. In measuring the camshaft for wear, the following procedure should be used:

   a. Remove camshaft and inspect visually for obvious damage.

   b. Using appropriate micrometer, measure each lobe of the cam and record measurement.

   c. Compare your measurement with specifications for the camshaft.

   d. Reinstall or replace camshaft as necessary.

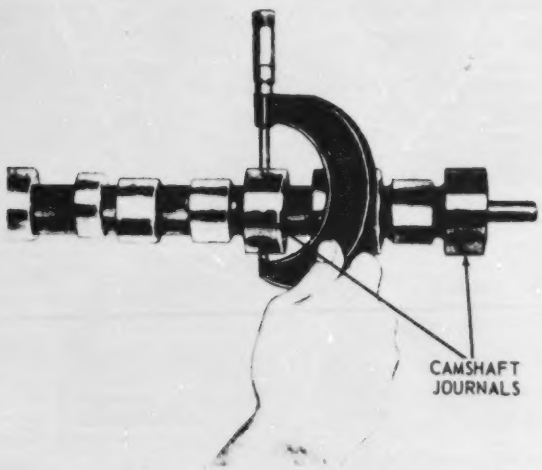


Figure 3. Measuring camshaft journals.
Courtesy of John Deere and Company

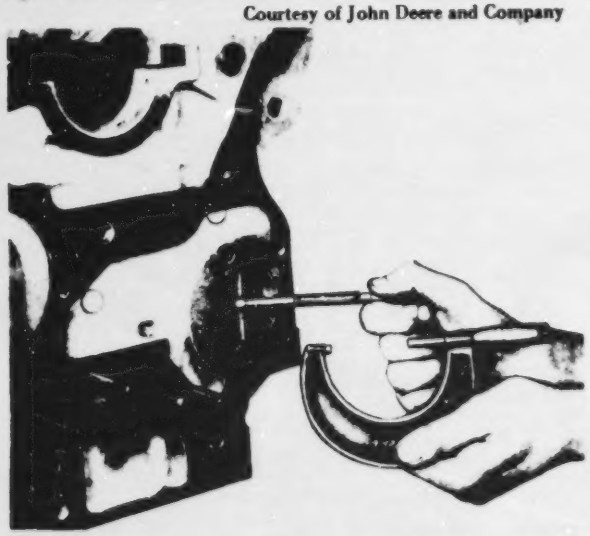


Figure 4. Measuring camshaft bores.
Courtesy of John Deere and Company

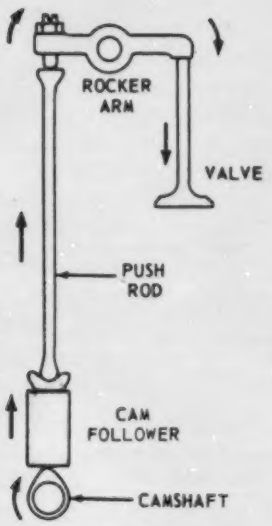


Figure 5. Cam follower.
Courtesy of John Deere and Company

2. In replacing the camshaft bearings, the following procedure should be used:

   a. Follow instructions in the manufacturer's service manual to remove all parts necessary to reach camshaft bearings.

   b. Read service manual to ascertain which bearings are the proper ones for the tractor being repaired. (NOTE: Bearings must match the camshaft. Some manufacturers have undersized bearings for replacement parts as well as special installation tools.)

   c. Line up the oil holes prior to and after assembly. Check the registry of these holes with those in the cylinder block with a wire.

   d. Reassemble according to manufacturer's instructions and specifications, checking the camfollowers, camlobes, and camshafts for damage or wear and adjusting to specifications outlined in the service manual.

   e. Reassemble all other parts removed.

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
SERVICING THE CAMSHAFT

Answer the following:

1. Each lobe of the camshaft should be measured with a feeler gauge and the results recorded. (T or F)

2. What is the function of the camshaft in the engine?

3. The camshaft journals should be inspected for:
   a.
   b.

4. If the cam lobes are rough or wavy, you should have the cams reground and polished. (T or F)

5. How can you make certain the camshaft bearing will be lubricated after assembly?

6. The camshaft turns at (a. 1/4, b. 1/2, or c. 2/3) the speed of the engine crankshaft.

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CORRECT RESPONSES

1. False—a micrometer should be used.
2. It opens and closes each valve at the proper time.
3. a. signs of wear
   b. out-of-round condition
4. False—regrinding and polishing the cams is not satisfactory on modern high-speed engines.
5. You should line up the oil holes in the bearing with those in the engine block prior to assembly and after assembly, making sure the holes line up by inserting a wire.
6. b. 1/2

CHECK-OUT ACTIVITIES

The statements below explain the activities you must be able to complete in order to finish this learning activity package. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING THE CAMSHAFT.

On the designated tractor:

Measure the camshaft for wear.

Replace the camshaft bearings.

DO NOT WRITE ON THIS PAGE

LAP 86

Student _____

Date _____

SERVICING THE CAMSHAFT

Instructor's Final Checklist

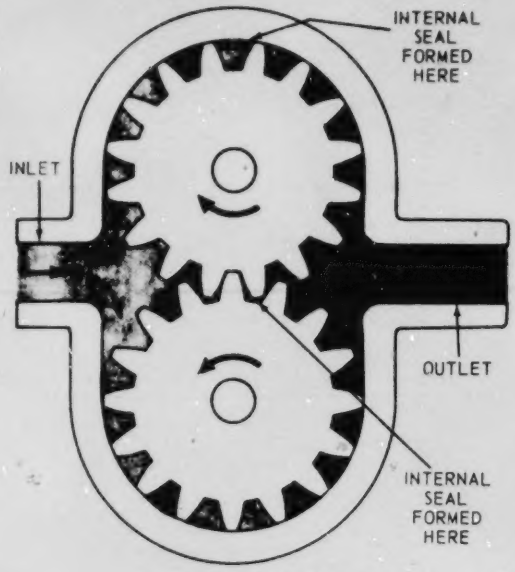
Check the student's performance in the following elements of servicing the camshaft.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In measuring the camshaft for wear, the student:				
a. removed and visually inspected the camshaft	[ ]	[ ]	[ ]	[ ]
b. took and recorded micrometer measurements of each camlobe	[ ]	[ ]	[ ]	[ ]
c. compared measurements with specifications	[ ]	[ ]	[ ]	[ ]
d. reinstalled or replaced the camshaft as necessary	[ ]	[ ]	[ ]	[ ]
2. In replacing the camshaft bearings, the student:				
a. studied the manufacturer's service manual for reaching the camshaft bearings	[ ]	[ ]	[ ]	[ ]
b. lined up the oil holes with those in the cylinder block	[ ]	[ ]	[ ]	[ ]
c. reassembled according to manufacturer's specifications	[ ]	[ ]	[ ]	[ ]
3. The camshaft turned properly and there was no damage to any parts	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 87



External Gear Pump

Courtesy of John Deere and Company

Servicing the Oil Pump

Tractor Mechanics

Objective no. 136

INTRODUCTION

All of the tractors that are brought into the shop for overhaul will need to have the oil pump serviced. Many times the mechanic will rebuild the oil pump to insure that sludge does not hinder its lubricating functions. The pump pushes out oil through the system and also traps it so that normal pressure can be built up in the system. If the oil pump does not function properly the engine will not be lubricated properly, resulting in excessive wear of the engine parts. In this learning activity package you will learn how to properly service the oil pump.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, go through the Learning Activities in the order given.

OBJECTIVE

Given a complete mechanic's tool set, oil, gaskets, solvent, and sealers, service the oil pump. All parts must be correctly reinstalled and there must be no oil leaks.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (John Deere Company), Chapter 7, pp. 7-3 and 7-4.

(or) _____

2 READ INSTRUCTIONS, SERVICING THE OIL PUMP.

(or) _____

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3 CHECK YOUR KNOWLEDGE of oil pumps by taking Student Self-Check, SERVICING OIL PUMPS.

4 STUDY the section on servicing the oil pump in the manufacturer's service manual for the designated tractor.

(or) _____

5 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or) _____

6 PRACTICE servicing the oil pump on the designated tractor. Follow the procedure outlined in INSTRUCTIONS and in the manufacturer's service manual.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 3.

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set

MATERIALS AND SUPPLIES NEEDED

1. Oil (approved by manufacturer)
2. Gaskets
3. Solvent
4. Sealers

SAFETY

1. Use Caution When Draining Hot Engine Oil.

INSTRUCTIONS

SERVICING THE OIL PUMP

When servicing the oil pump, the following procedure should be used:

1. Remove oil level dip stick and drain out engine oil.
2. Remove any parts necessary to make oil pump accessible, and jack up transmission if necessary.
3. Remove the retaining bolts from oil pan sump.
4. Remove oil pan sump.
5. Clean dirt from inside the sump.
6. Scrape gasket material from gasket surface.
7. Wash sump in solvent and dry completely.

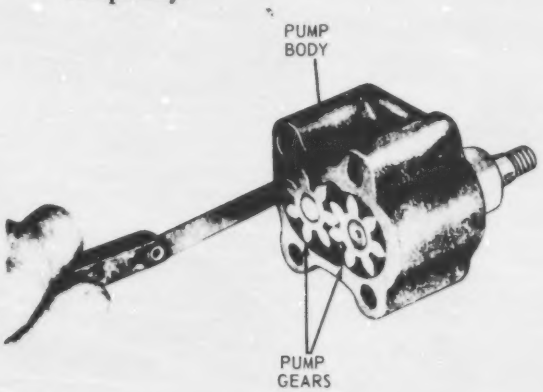


Figure 1. Measuring clearance between pump gears and housing.
Courtesy of John Deere and Company

8. Check pan for damage (repair or replace if necessary).
9. Replace gasket. (Gasket surfaces should be clean; position gasket on the cylinder block and apply gasket sealer on gasket, front cover, and oil pan.)
10. Reinstall oil pan sump and bolts.
11. Reinstall all other parts.
12. Replace oil and dip stick.
13. Run engine and check for oil leaks and oil pressure.

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!

SERVICING OIL PUMPS

1. Label the types and parts of pumps in the following diagrams.

   a. Figure A: type of pump

   b. Figure B: type of pump

   c. g.
   d. h.
   e. i.
   f. j.

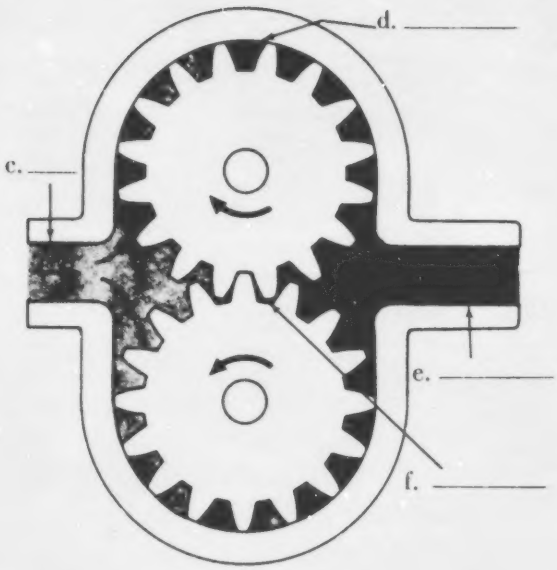


Figure A. a. _____

Courtesy of John Deere and Company

2. The pump in Figure A is driven from the _____, while the pump in Figure B is driven from the_____.

3. Where can we expect to find most of the wear on the Figure A pump?

4. Where can we expect fo find most of the wear on the Figure B pump?

5. Why do we need to be careful not to damage the mounting surfaces of either the housing or cover?

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING THE OIL PUMP.

Service the oil pump on the designated tractor.

Courtesy of John Deere and Company

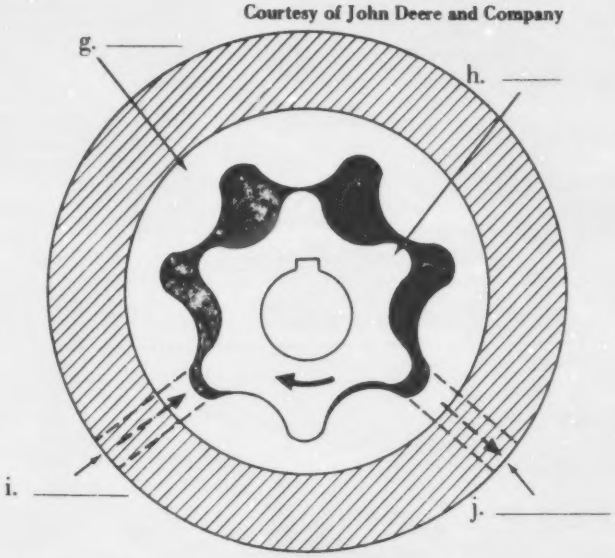


Figure B. b. _____

CORRECT RESPONSES

1. a. External gear pump
   b. Rotor pump
   c. Inlet
   d. Internal seal formed here
   e. Outlet
   f. Internal seal formed here
   g. Rotor ring
   h. Inner rotor
   i. Inlet
   j. Outlet

2. camshaft, crankshaft

3. between the teeth of the gear

4. Most of the wear will be found between the lobes of the inner rotor and the lobes on the rotor ring.

5. Many pumps do not use a gasket, and these machined surfaces form the only seal.

DO NOT WRITE ON THIS PAGE

LAP 87

Student _____

Date _____

SERVICING THE OIL PUMP

Instructor's Final Checklist

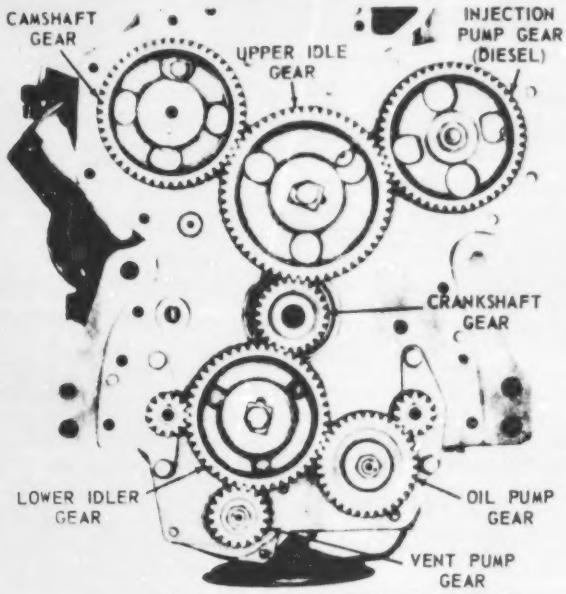
Check the student's performance in the following elements of servicing the oil pump.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	In servicing the oil pump, the student:				
	a. drained engine oil	[ ]	[ ]	[ ]	[ ]
	b. removed parts to make oil pump accessible	[ ]	[ ]	[ ]	[ ]
	c. removed the oil pan sump retaining bolts	[ ]	[ ]	[ ]	[ ]
	d. removed the oil pan sump	[ ]	[ ]	[ ]	[ ]
	e. cleaned and dried the sump	[ ]	[ ]	[ ]	[ ]
	f. replaced gasket	[ ]	[ ]	[ ]	[ ]
	g. reinstalled the oil pan sump and bolts	[ ]	[ ]	[ ]	[ ]
	h. reinstalled other parts	[ ]	[ ]	[ ]	[ ]
	i. replaced engine oil	[ ]	[ ]	[ ]	[ ]
	j. ran the engine to check for oil leaks and oil pressure	[ ]	[ ]	[ ]	[ ]
2.	The engine showed no oil leaks	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 88



Timing Gear Train On Typical Engine

Courtesy of John Deere and Company

Installing the Timing Gear or Chain

Tractor Mechanics

Objective no. 105

INTRODUCTION

An engine must be timed correctly if it is going to function properly. Many engine gears must be timed to each other. Timing of these gears is done by matching timing marks when the gears are installed. If the gears are not aligned properly the complete operation of the engine will be thrown off. The engine will knock, overheat, backfire, and if it is off very much, it will not run at all. In this learning activity package you will learn how to properly install a timing gear or chain.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, go through the Learning Activities in the order given.

OBJECTIVE

Given a timing gear or chain, a mechanic's tool set, and pullers for the engine being worked on, install the timing gear or chain on the designated tractor. All parts must be assembled in correct order and the timing must be to manufacturer's specifications.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (John Deere Company), Chapter 2, p. 62.

(or) _____

2 READ INSTRUCTIONS, INSTALLING THE TIMING GEAR OR CHAIN.

(or) _____

3 CHECK YOUR KNOWLEDGE of the timing chain and gear by taking the Student Self- Check, INSTALLING THE TIMING CHAIN OR GEAR.

4 STUDY the section on timing gears in the manufacturer's service manual for the designated tractor. Compare the procedure outlined in Learning Activity 2 to that in the service manual.

(or) _____

5 OBSERVE another student as he or she satisfactorily performs and completes this learning activity package.

(or) _____

6 PRACTICE installing the timing gear or chain on the designated tractor. Follow the procedure outlined in Learning Activity 2 and the manufacturer's service manual.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 3.

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set
2. Gear Pullers
3. Hoist
4. Jack Stands

MATERIALS AND SUPPLIES NEEDED

1. Timing Chain or Gear
2. I & T Shop Manual

SAFETY

The engine block is very heavy. Make sure it is secured before servicing.

INSTRUCTIONS

INSTALLING THE TIMING GEARS OR CHAIN

When installing the timing gears or chain, the following procedure should be used:

1. After removing other parts, depending on type of tractor, remove timing chain (or timing gear) cover. Note: This will require removal of radiator and the front end on most tractors.
2. Crank engine and observe alignment of timing marks. If marks are not present, make marks on each gear so that it can be reassembled properly. See drawing on timing gears.
3. Unbolt cam shaft gear (sprocket).
4. Pull gear (sprocket) from camshaft with appropriate pullers. Note: On timing chain assemblies, the camshaft sprocket, chain, and crankshaft should be removed as an assembly. Although the camshaft should be keyed so the gear (sprocket) can be installed one way, note position for reassembly.

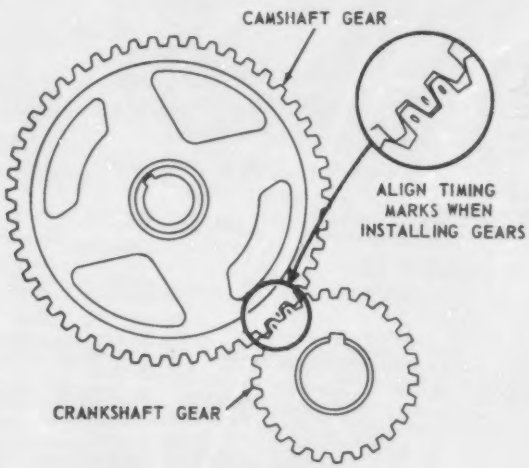


Figure 1. Timing of engine gears.
Courtesy of John Deere and Company

5. Reassemble and install timing parts with timing marks correctly aligned.
6. Reassemble other parts as necessary.

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
INSTALLING THE TIMING GEARS OR CHAIN

Check your knowledge of timing chains or gears by answering the following.

1. The crankshaft is the "hub" around which other parts of the engine can be timed. (T or F)

2. Which of the following accessories are not operated through the timing gear?

   a. fuel pumps
   b. turbocharger
   c. hydraulic cylinder pumps
   d. oil pumps
   e. injection pumps (diesel)
   f. ventilator pumps
   g. water pumps

3. How is the timing of gears done?

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, INSTALLING THE TIMING GEARS OR CHAIN.

Install a timing chain or gears on the designated engine.

CORRECT RESPONSES

1. True
2. b and c
3. By matching timing marks when the gears are installed.

DO NOT WRITE ON THIS PAGE

LAP TM–88

Student _____

Date _____

INSTALLING THE TIMING GEARS OR CHAIN

Instructor's Final Checklist

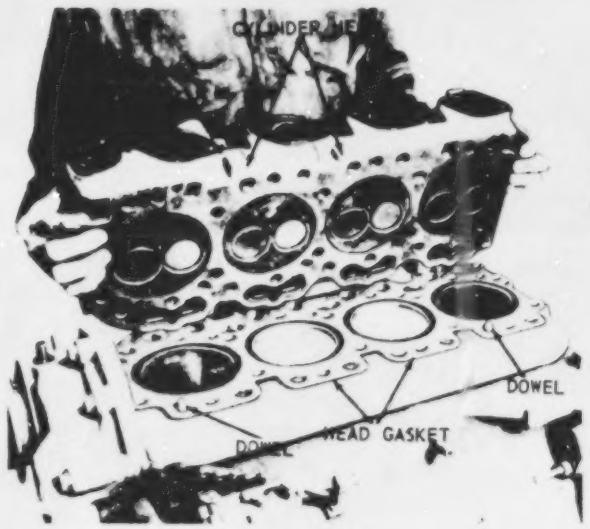
Check the student's performance in the following elements of installing the timing gears or chain.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. When installing the timing gears, the student:				
a. removed the timing gear cover	[ ]	[ ]	[ ]	[ ]
b. cranked engine observing the alignment of the timing marks	[ ]	[ ]	[ ]	[ ]
c. unbolted the camshaft gear	[ ]	[ ]	[ ]	[ ]
d. pulled the gear from camshaft	[ ]	[ ]	[ ]	[ ]
e. reassembled and installed the timing parts with the timing marks correctly aligned	[ ]	[ ]	[ ]	[ ]
2. All parts were assembled in correct order	[ ]	[ ]	[ ]	[ ]
3. Timing was to manufacturer's specifications	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 89



Replacing the Cylinder Head

Tractor Mechanics

Courtesy of John Deere and Company

Objective nos. 93,99

INTRODUCTION

A mechanic should always check the engine head and block for warpage when doing an overhaul. The head and block will be subjected to various stress conditions such as overheating and high compression. These stress conditions may cause defects in the head and block, such as warpage and cracks, which result in poor engine compression and power. The warpage will also allow water and oil to seep into the compression chamber. In this learning activity package you will learn how to check the cylinder head and block for warpage and to install the cylinder head.

DIRECTIONS

Read the objectives below. If you believe you are already able to perform these tasks, read the Check-Out Activities on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or,

If you need to complete learning activities in order to be able to do the tasks, go through the Learning Activities in the order given.

OBJECTIVES

1. Given a cylinder head and block, a straight-edge, and a feeler gauge, check cylinder head and block for warpage and mark all excessive warpage.

2. Given a mechanic's tool set and manufacturer's service manual, install a cylinder head on the designated tractor. All parts should be installed with no visible leaks and torqued to service manual specifications.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (John Deere Company), Chapter 2, pp. 4-5.

(or) _____

2 READ INSTRUCTIONS, REPLACING THE CYLINDER HEAD.

(or) _____

3 CHECK YOUR KNOWLEDGE of cylinder heads by taking Student Self-Check, REPLACING CYLINDER HEADS.

4 STUDY the section on replacing cylinder heads in the manufacturer's service manual for the designated tractor.

(or) _____

5 PRACTICE replacing the cylinder head on the designated tractor. Follow the procedure outlined in INSTRUCTIONS, REPLACING CYLINDER HEADS, and the manufacturer's service manual.

6 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 4.

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set
2. Straight Edge
3. Feeler Gauge - Flat - Thickness
4. Cylinder Head and Block
5. Torque Wrench

MATERIALS AND SUPPLIES NEEDED

1. New Head Gasket and Valve Cover Gasket
2. Gasket Sealing Compound

SAFETY

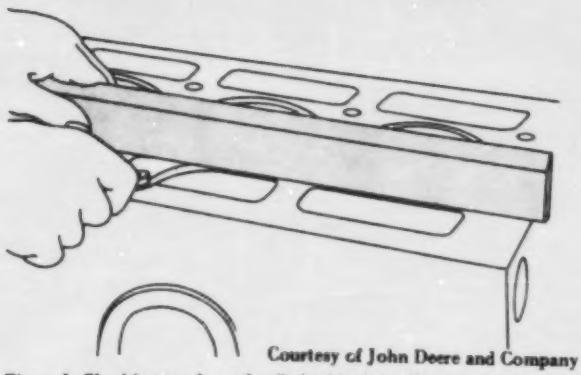
No Special Safety Precautions

INSTRUCTIONS

REPLACING THE CYLINDER HEAD

1. In checking the cylinder head and block for warpage, the following procedure should be used:

   a. Remove and clean the head.



Courtesy of John Deere and Company

Figure 1. Checking top face of cylinder block for flatness.

   b. Lay a straight-edge across the head.

   c. Check with feeler gauge under straight-edge for clearance. (Generally the clearance must not exceed .001 inch (.0025 cm) per one inch (2.54 cm) .003 inch (.0076 cm) per six inches (15.24 cm), or .008 inch (.020 cm) for the complete length of the head.)

   d. Check mating surface of the block in the same way.

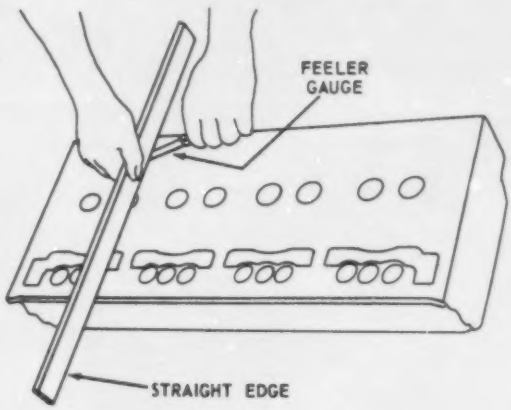


Figure 2. Checking the head for warpage.

Courtesy of John Deere and Company

   e. Mark all excess warpage.

   f. If warpage is beyond limits, it should be taken to a machine shop and the head surfaced to correct this difference.

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2. When installing the cylinder head, the following procedure should be used:

   a. With old head removed, block and piston tops cleaned, and valves ground in place, coat mating surface of the block with gasket sealing compound when compound is recommended.

   b. Install new head gasket, right side up (The side which goes toward the head should be so marked.)

   c. Coat top of head gasket with sealing compound if compound is recommended.

   d. Lower head in place, being careful not to shift head gasket.

   e. Install head bolts hand tight.

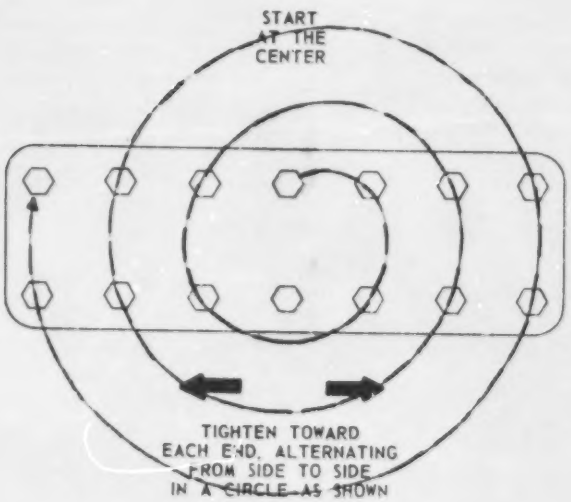


Figure 3. Guide to proper sequence for tightening cylinder heads.
Courtesy of John Deere and Company

   f. Install head bolts using a spiral sequence, and tightening in steps of about 10 ft. lb. until specified torque is reached. (See illustration.)

STUDENT SELF-CHECK **LAP 89**
DO NOT WRITE ON THIS PAGE!
REPLACING CYLINDER HEADS

Answer the following:

1. When checking the warpage of the cylinder head, generally the clearance must not exceed (a)____ per one inch, (b)____ per six inch, or (c)____ for the complete length of the head.

2. Describe the general procedure in tightening the head bolts.

3. When removing the cylinder head it is alright to tap the head lightly with a soft-faced hammer to loosen it. (T or F)

4. Carbon should not be removed from the cylinder head with a wire brush. (T or F)

5. What generally causes the engine head to warp?

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CORRECT RESPONSES

1. a. .001 in. (.00254 cm)
   b. .003 in. (.0076 cm)
   c. .008 in. (.020 cm)

2. Tighten the bolts down finger tight. Start at the center of the head and work out to both ends of the head within 10 ft. lb. (13.56 newton-meters) increments until the specified torque is reached.

3. True

4. False

5. Overheating

CHECK-OUT ACTIVITIES

The statements below explain the activities you must be able to complete in order to finish this learning activity package. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, REPLACING THE CYLINDER HEAD.

On the designated tractor:

Check the cylinder head and engine block for warpage.

Install a cylinder head.

DO NOT WRITE ON THIS PAGE

LAP 89

Student _____

Date _____

REPLACING THE CYLINDER HEAD

Instructor's Final Checklist

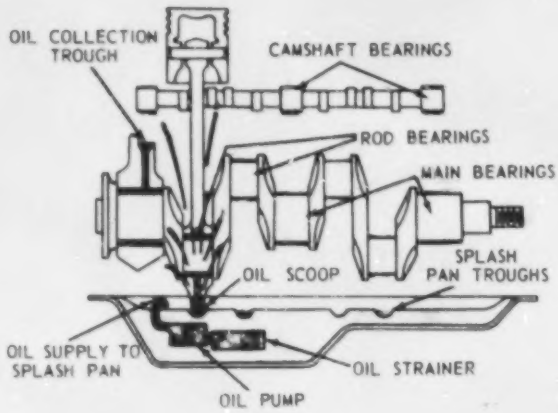
Check the student's performance in the following elements of replacing the cylinder head.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	In checking the cylinder head and block for warpage, the student:				
	a. laid a straight-edge across the head	[ ]	[ ]	[ ]	[ ]
	b. checked with a feeler gauge under straight-edge for clearance	[ ]	[ ]	[ ]	[ ]
	c. checked the block in the same manner as the head was checked	[ ]	[ ]	[ ]	[ ]
	d. marked all excessive warpage	[ ]	[ ]	[ ]	[ ]
2.	When installing the cylinder head, the student:				
	a. installed a new head gasket	[ ]	[ ]	[ ]	[ ]
	b. put sealing compound on top of the head gasket	[ ]	[ ]	[ ]	[ ]
	c. installed and tightened the head bolts using a spiral sequence of 10 ft. lbs. until the specified torque was reached	[ ]	[ ]	[ ]	[ ]
	d. re-torqued head after a few hours of light duty operation	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 90



Replacing the Oil Pan

Tractor Mechanics

Courtesy of John Deere and Company

Objective no. 119

INTRODUCTION

The oil pan and gasket are the last parts a mechanic will replace on the engine block after an overhaul. Since the oil pan is used to store oil in the lubricating system, it must have a tightly fitting gasket which will keep the oil from seeping out and will also allow sludge deposits to settle in the bottom of the pan. The mechanic should clean the pan thoroughly before reinstalling it on the engine after an overhaul. In this learning activity package you will learn how to properly replace the oil pan.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, go through the Learning Activities in the order given.

OBJECTIVE

Given a mechanic's tool set and a torque wrench, gasket and gasket compound, replace the oil pan and gasket assembly. The oil pan must be clean, the gasket must be in place and sealed, and the bolts must be tightened to the correct torque.

LEARNING ACTIVITIES

1 READ INSTRUCTIONS, REPLACING THE OIL PAN.

(or) _____

2 STUDY the section on replacing oil pans in the manufacturer's service manual for the designated tractor.

(or) _____

3 CHECK YOUR KNOWLEDGE by taking Student Self-Check, REPLACING THE OIL PAN.

(or) _____

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4 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or) _____

5 PRACTICE replacing the oil pan on the designated tractor. Follow the procedure outlined in INSTRUCTIONS, REPLACING THE OIL PAN, and the manufacturer's service manual.

6. ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 3.

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set
2. Torque Wrench
3. Steam Cleaner

MATERIALS AND SUPPLIES NEEDED

1. Gasket and Gasket Compound
2. Oil for Designated Tractor
3. Solvent

SAFETY

No Special Precautions

INSTRUCTIONS

REPLACING THE OIL PAN

In replacing the oil pan, the following procedure should be used:

1. Drain engine oil.
2. Remove oil pan.
3. Clean oil, sludge, dirt, and old gasket from oil pan.

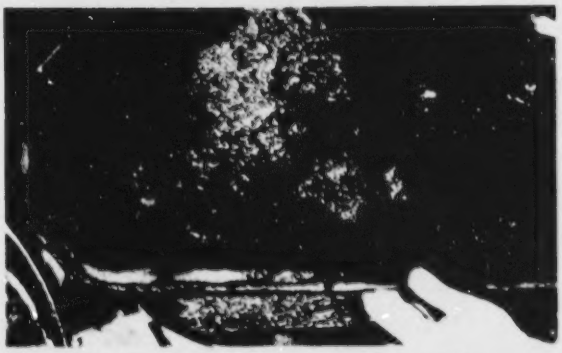


Figure 1. Ice in crankcase following cold engine operation.
Courtesy of John Deere and Company

4. Clean all traces of old oil pan gasket from engine block.
5. Coat bottom side of gasket with gasket compound and install on oil pan.
6. Coat top of gasket with gasket compound.
7. Carefully lift pan and gasket into place on engine and run bolts up hand tight. Refer to manufacturer's service manual for torque specification.
8. Torque bolts in 5 ft. lb. (6.78 newton-meters) increments until specified torque is reached.

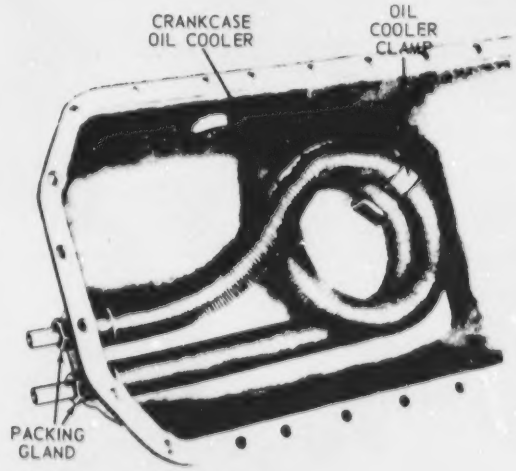


Figure 2. Internal oil cooler in crankcase.
Courtesy of John Deere and Company

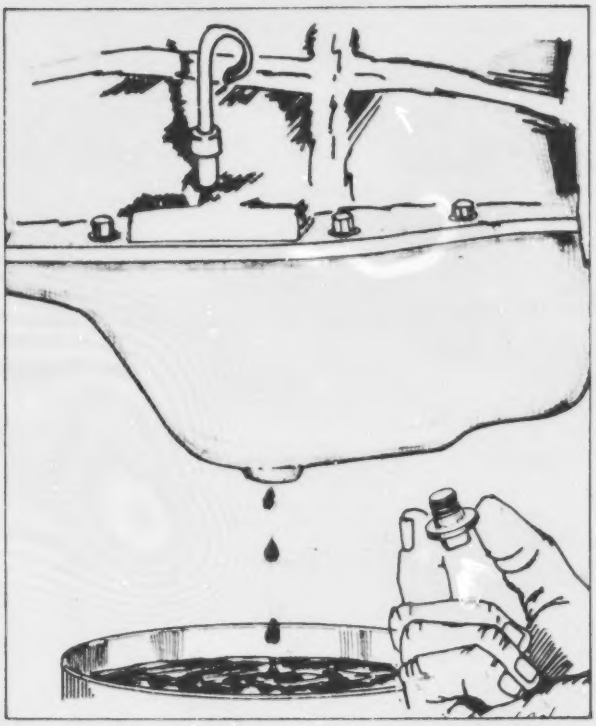


Figure 3. Draining crankcase oil.

Courtesy of the American Association for Vocational Instructional Materials

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
REPLACING THE OIL PAN

1. What is the purpose of the oil pan?

2. Why is it necessary to have a gasket between the engine block and oil pan?

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. The oil pan is used to store oil in the lubricating system and to collect sludge from the oil.

2. A gasket is necessary to prevent oil from seeping from the lubricating system.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, REPLACING THE OIL PAN.

Replace the oil pan on the designated tractor.

DO NOT WRITE ON THIS PAGE

LAP 90

Student _____

Date _____

REPLACING THE OIL PAN
Instructor's Final Checklist

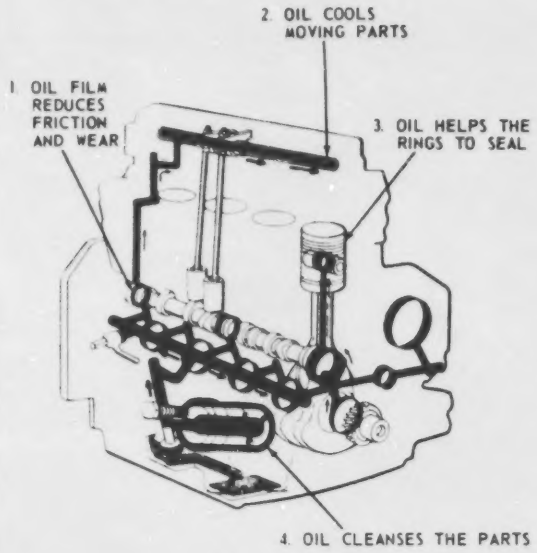
Check the student's performance in the following elements of replacing the oil pan.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. When replacing the oil pan, the student:				
a. cleaned sludge and dirt from the oil pan	[ ]	[ ]	[ ]	[ ]
b. cleaned all traces of the old gasket from the oil pan and engine block	[ ]	[ ]	[ ]	[ ]
c. coated the gasket with gasket compound before installing	[ ]	[ ]	[ ]	[ ]
d. lifted the pan and gasket carefully into place on the engine	[ ]	[ ]	[ ]	[ ]
e. torqued the pan bolts to manufacturer's specifications	[ ]	[ ]	[ ]	[ ]
2. The oil pan, after being installed by the student, had no leaks	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 91



Courtesy of John Deere and Company

Inspecting the Lubricant Level on a Tractor

Tractor Mechanics

Objective nos. 130,131,132

INTRODUCTION

The most important parts of a tractor are the engine, transmission, and differential. To make sure that these systems will perform at maximum efficiency with minimum wear and overheating, proper lubricant levels must be maintained. In this learning activity package you will learn to check the oil level of the engine crankcase, the transmission and the differential.

DIRECTIONS

Read the objectives below. If you believe you are already able to perform these tasks, read the Check-Out Activities on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or,

If you need to complete learning activities in order to be able to do the tasks, turn to p. 2 and go through the Learning Activities in the order given.

OBJECTIVE

1. Given a clean cloth and oil, check the engine crankcase oil level. Upon completion the dip stick reading must agree with that of the instructor.

2. Given a shop rag, check the transmission and/or differential lubricant level on an engine equipped with a dip stick. The dip stick should be clean when inserted and the student's reading should be the same as the instructor's.

3. Given a wrench to fit the type of plug head and proper lubricant, check the transmission and/or differential lubricant level on a plug-equipped engine. The engine must have the proper oil level as specified in the manufacturer's service manual, and the plug must be tight when the operation is complete.

LEARNING ACTIVITIES

1 READ *Tractor Operation and Daily Care* (AAVIM), pp. 7-8 and *Tractor Maintenance: Principles and Procedures* (AAVIM), p.88.

(or) _____

2 READ INSTRUCTIONS A, CHECKING ENGINE CRANKCASE OIL LEVEL, and INSTRUCTIONS B, CHECKING THE TRANSMISSION AND/OR DIFFERENTIAL LUBRICANT LEVELS.

3. READ the manufacturer's service manual for location of plugs and dip sticks and for recommended lubrication.

(or) _____

4 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or) _____

5 PRACTICE checking oil level in crankcase, transmission and/or differential. Follow the procedure outlined in Instructions A and B and the manufacturer's service manual.

6 ARRANGE with your instructor to complete this by going through the CHECK-OUT ACTIVITIES listed on page 4.

TOOLS AND EQUIPMENT NEEDED

1. Plug Wrench

MATERIALS AND SUPPLIES NEEDED

1. Cloth Rags

SAFETY

1. Guard against burns from a hot engine if tractor has been recently operated.

2. Do not check lubricant levels on a tractor with the engine running.

CHECKING ENGINE CRANKCASE OIL LEVEL

In checking the engine crankcase oil level, follow this procedure:

1. Turn off the engine if it is in operation. (Tractor should be level.)

2. Locate dip stick on the left or right side of the engine, depending on make of tractor.

3. Pull out the dip stick and wipe dry with a clean cloth.

4. Reinsert the dip stick and seat fully.

5. Pull out the dip stick and take a reading.

6. Replace the dip stick.

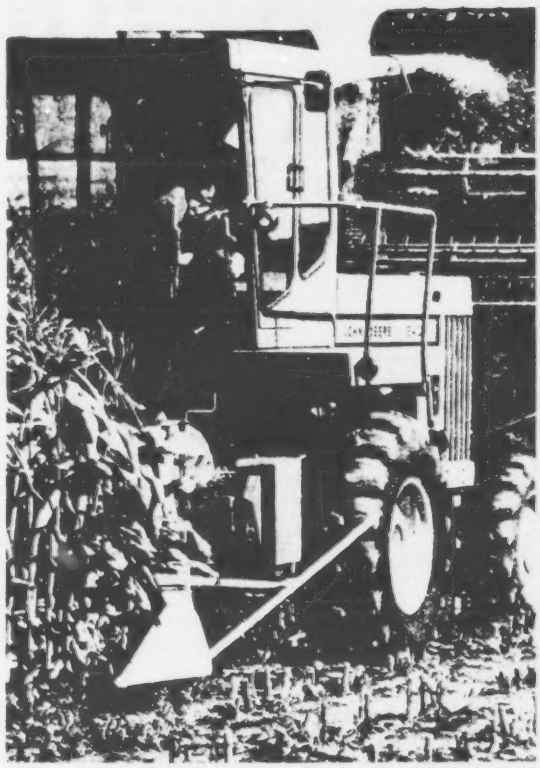


Figure 1. Engines used in agricultural equipment require frequent oil changes when used in dusty conditions.

Courtesy of John Deere and Company

INSTRUCTIONS B

CHECKING THE TRANSMISSION AND/OR DIFFERENTIAL LUBRICANT LEVELS

In checking the transmission and/or differential lubricant on an engine equipped with a dip stick, follow this procedure:

1. Pull tractor onto level surface and turn off engine.
2. Locate dip stick on left or right side of tractor transmission and/or differential.
3. Pull out the dip stick.
4. Wipe the dip stick with a clean rag.
5. Reinsert the dip stick and seat fully.
6. Pull out the dip stick and take a reading.
7. Replace the dip stick.

In checking the transmission and/or differential lubricant on an engine equipped with a plug, follow this procedure:

1. Pull tractor onto level surface and turn off engine.
2. Remove the level-check plug.
3. If oil flows out when the plug is removed, no additional oil is necessary.
4. Replace the plug.
5. If oil does not flow out when the plug is removed, additional oil is necessary.
6. Locate the filler plug and wipe the surrounding surface clean.
7. Remove the filler plug.
8. Check the manufacturer's service manual and add the correct lubricant until it overflows from the level-check hole.
9. Replace the level-check plug and filler plug.

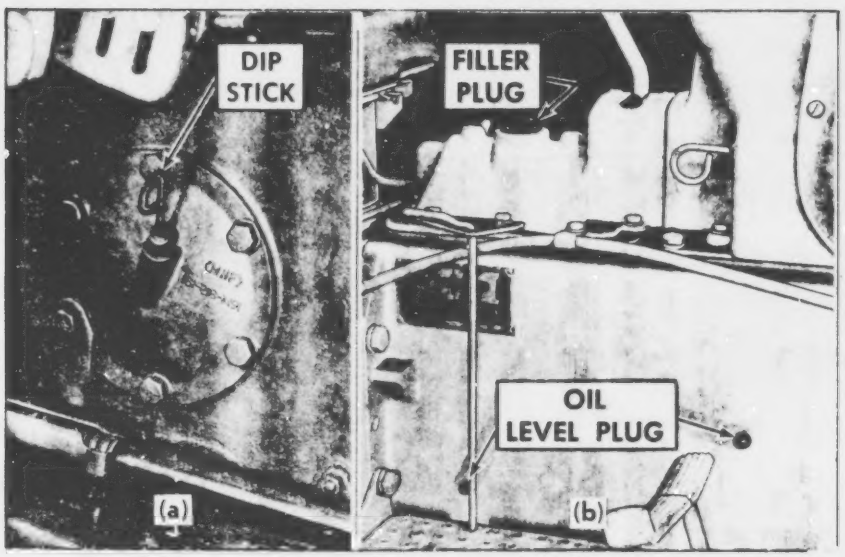


Figure 2. Means provided for checking gear-oil level on tractors, (a) dip stick (b) oil-level plugs on side of gear case.

Courtesy of the American Association for Vocational Instructional Materials

STUDENT SELF-CHECK
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INSPECTING THE LUBRICANT LEVEL ON A TRACTOR

1. Why must the tractor be placed on level ground before the oil levels are checked?

2. True or False. Since the oil is probably dirty anyway, a clean cloth is not needed to check the oil levels.

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITIES

The statements below explain the activities you must be able to complete in order to finish this learning activity package. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, INSPECTING THE LUBRICANT LEVEL ON A TRACTOR.

Check the engine crankcase oil level on the designated tractor.

Check the transmission and/or differential lubricant on a designated engine equipped with a dip stick.

Check the transmission and/or differential lubricant level on a designated engine equipped with a plug.

CORRECT RESPONSES

1. The tractor must be placed on level ground so that the engine or transmission oils will be level in relation to the tractor, and an accurate measure of the amount of oil can be taken.

2. False

DO NOT WRITE ON THIS PAGE

LAP 91

Student _____

Date _____

INSPECTING THE LUBRICANT LEVEL ON A TRACTOR

Instructor's Final Checklist

Check the student's performance in the following elements of inspecting the lubricant level on a tractor.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In checking engine crankcase oil level, the student:				
a. placed tractor on level and turned off the engine	[ ]	[ ]	[ ]	[ ]
b. pulled out dip stick and wiped dry with clean cloth	[ ]	[ ]	[ ]	[ ]
c. reinserted dip stick and seated fully	[ ]	[ ]	[ ]	[ ]
d. pulled out dip stick and took a reading	[ ]	[ ]	[ ]	[ ]
e. replaced dip stick	[ ]	[ ]	[ ]	[ ]
f. obtained same dip stick reading as instructor	[ ]	[ ]	[ ]	[ ]
2. In checking transmission and/or differential lubricant levels of a tractor with a dip stick, the student:				
a. pulled out dip stick and wiped with a clean cloth	[ ]	[ ]	[ ]	[ ]
b. reinserted dip stick and seated fully	[ ]	[ ]	[ ]	[ ]
c. pulled out dip stick and took a reading	[ ]	[ ]	[ ]	[ ]
d. replaced dip stick	[ ]	[ ]	[ ]	[ ]
e. obtained same dip stick reading as instructor	[ ]	[ ]	[ ]	[ ]

DO NOT WRITE ON THIS PAGE

LAP 91

Student _____

Date _____

INSPECTING THE LUBRICANT LEVEL ON A TRACTOR
(Continued)

Instructor's Final Checklist

Check the student's performance in the following elements of inspecting the lubricant level on a tractor.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
3. In checking transmission and/or differential lubricant levels, the student:				
a. removed level-check plug	[ ]	[ ]	[ ]	[ ]
b. replaced plug when oil flowed out	[ ]	[ ]	[ ]	[ ]
c. cleaned surface of filler plug	[ ]	[ ]	[ ]	[ ]
d. removed filler plug	[ ]	[ ]	[ ]	[ ]
e. checked manufacturer's service manual to determine correct lubricant use	[ ]	[ ]	[ ]	[ ]
f. added correct lubricant until oil flowed out from check plug	[ ]	[ ]	[ ]	[ ]
g. replaced check plug	[ ]	[ ]	[ ]	[ ]
h. replaced filler plug	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 92

Metal Edge Filter

Courtesy of John Deere and Company

Changing the Crankcase Oil and Filter

Tractor Mechanics

Objective nos. 128,129

INTRODUCTION

After about 100 hours of operation,the oil in a tractor will be so contaminated with soot, varnish-forming materials, metal particles, water, unburned fuel, dirt, and dust that sludge will begin to develop on pistons, valve lifters, and rings. The oil filter will remove most of these particles until it becomes clogged as a result of more than 100 hours of filtering operation. This causes more sludge-forming deposits to remain suspended in the oil, causing more sludge to form on operating parts. The sludge causes excessive wear of engine parts, resulting in costly engine repairs. To avoid this trouble, the oil and filter must be changed regularly according to the manufacturer's service manual. In this learning activity package you will learn how to change the crankcase oil and oil filter.

DIRECTIONS

Before you begin this learning activity package, be sure you have completed Learning Activity Package 91, INSPECTING THE LUBRICANT LEVEL ON A TRACTOR.

If you have completed this Learning Activity Package, read the objectives below. If you feel you are already able to perform these tasks, read the Check-Out Activities on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or,

If you need to complete learning activities in order to be able to do the tasks, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVES

1. Given a wrench for the drain plug, new oil of the type and grade recommended in the manufacturer's service manual, clean rags, and a container for the old oil, change the tractor oil. When completed, the dip stick must show the oil is at (but not exceeding) the "full" mark and there will be no leaks.

2. Given the manufacturer's service manual, a replacement filter, fresh oil and the necessary tools, change the oil filter. When finished, the filter must not leak. The oil must be at the "full" line.

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LEARNING ACTIVITIES

1 READ *Tractor Maintenance: Principles and Procedures* (AAVIM), pp. 29-36.

(or) _____

2 CHECK YOUR KNOWLEDGE of filter systems by taking Student Self-Check, UNDERSTANDING OIL FILTERING SYSTEMS.

3 CONSULT the manufacturer's service manual for the location of the crankcase drain plug, fill plug, the type of oil filter required, and the oil type recommended for the designated tractor.

(or) _____

4 STUDY the manufacturer's service manual to determine the correct procedure for removing the oil filter from the designated tractor.

(or) _____

5 READ INSTRUCTIONS, CHANGING THE TRACTOR CRANKCASE OIL AND FILTER.

(or) _____

6 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or) _____

7 PRACTICE changing the crankcase oil and filter.

8 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 4.

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set
2. Oil Filter Wrench (for surface type filters)
3. Container for Old Oil
4. Oil Spout

MATERIALS AND SUPPLIES NEEDED

1. Proper Grade of Oil
2. Oil Filter
3. Operator's Manual

SAFETY

REMEMBER - Hot Manifolds Can Burn

INSTRUCTIONS

CHANGING THE CRANKCASE OIL AND FILTER

There are two basic filtration systems: by-pass and full-flow; and two basic types of filters: surface type (spin out) and depth type (cartridge). Oil should be drained and replaced when new filters are installed.

1. Operate engine until normal operating temperature is reached. This enables the oil to become less viscous and therefore drain better and carry out more of the impurities.
2. Stop engine and disconnect coil wire.
3. Locate and clean around drain plug and then remove.

Figure 1. (a) Use a wrench for removing drain plug. (b) Remove particles accumulated on magnetic drain plug by striking it against a board or solid object. Be careful not to damage the threads.

Courtesy of the American Association for Vocational Instructional Materials

4. Allow crankcase to drain for about five (5) minutes.

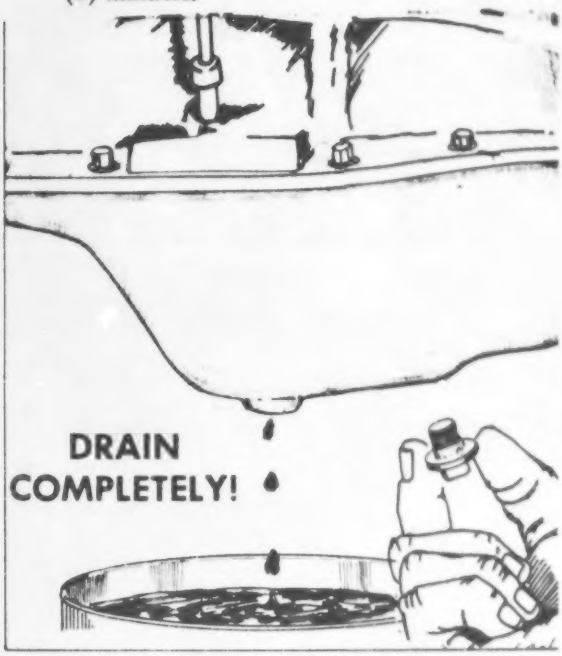


Figure 3. Allow crankcase oil to drain completely.

Courtesy of the American Association
for Vocational Instructional Materials

5. Locate and replace oil filter with same type.

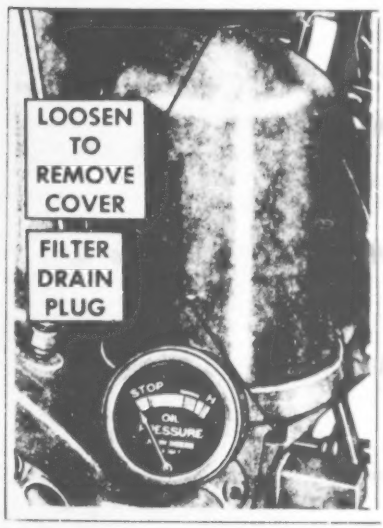


Figure 3. Oil filter located on side of engine.

Courtesy of the American Association
for Vocational Instructional Materials

Figure 4. Oil filter located under engine crankcase.

Courtesy of the American Association
for Vocational Instructional Materials

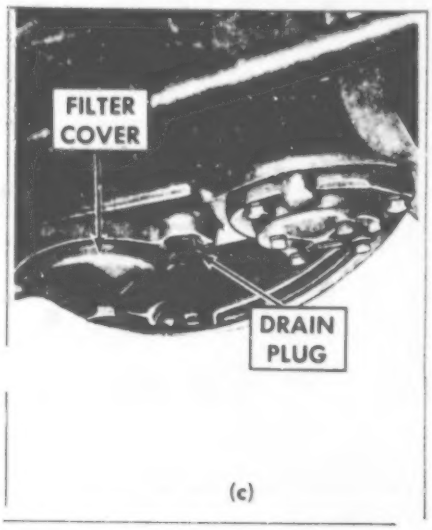


Figure 5. Oil filter mounted inside crankcase.

Courtesy of the American Association
for Vocational Instructional Materials

6. Flush crankcase, according to directions given in the operator's manual.

7. If oil plug has a copper washer, check for damage before replacing plug. After this check is made, replace drain plug and refill crankcase with new oil of the type recommended in the service manual. One extra quart is usually required above normal oil change for filter.

8. Connect coil wire and start engine. Check oil pressure. Operate until warm and check for oil leaks. Stop engine and check oil level, adding more if needed.

9. CAUTION: Do not overfill; this is just as damaging as not having sufficient oil.

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
UNDERSTANDING OIL FILTERING SYSTEM

1. The two basic kinds of oil filter systems are _____ and _____.

2. The two basic types of filters are:

3. No oil filter is better than a DIRTY filter. (T or F)

4. Disconnecting the coil wire is a safety measure as well as preventing engine from starting with no oil in it. (T or F)

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. By-pass system, Full-flow system
2. Cartridge, Spin-on
3. False
4. True

CHECK-OUT ACTIVITIES

The statements below explain the activities you must be able to complete in order to finish this learning activity package. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, CHANGING THE CRANKCASE OIL AND FILTER.

Change the oil in the designated tractor.

Change the oil filter on the designated tractor.

DO NOT WRITE ON THIS PAGE

LAP 92

Student _____

Date _____

CHANGING THE CRANKCASE OIL AND FILTER

Instructor's Final Checklist

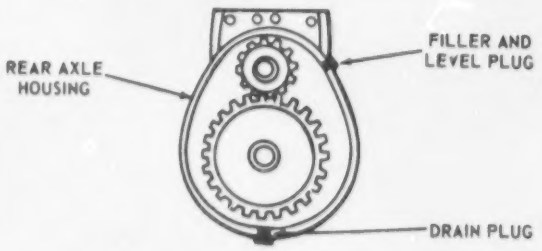
Check the student's performance in the following elements of changing the crankcase oil and filter.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
In changing the crankcase oil and filter, the student:				
1. Ran engine until operating temperature reached	[ ]	[ ]	[ ]	[ ]
2. Disconnected coil wire	[ ]	[ ]	[ ]	[ ]
3. Cleaned drain	[ ]	[ ]	[ ]	[ ]
4. Cleaned oil can before inserting spout	[ ]	[ ]	[ ]	[ ]
5. Checked washer or gasket on plug	[ ]	[ ]	[ ]	[ ]
6. Checked for leaks	[ ]	[ ]	[ ]	[ ]
7. Did not over fill	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 93



Changing Differential Lubricant

Tractor Mechanics

Courtesy of John Deere and Company

Objective no. 133

INTRODUCTION

The differential on a tractor has the job of transferring the power from the engine to the wheels. It is made up of a complex system of gears. The pinion gear receives the power from the engine and rotates the ring gear. A set of bevel pinions mounted inside the ring gear transfers the power from the ring gear to the bevel gears on the axle, which in turn move the wheels. Because of the great stress placed upon these gears, it is very important that they be maintained with the proper lubricant. To avoid expensive repair and loss of operating time, the lubricant must be changed regularly. In this learning activity package you will learn how to change the lubricant in the differential of a tractor.

DIRECTIONS

Before you start to work on this learning activity package, be sure you have completed Learning Activity Package 91, INSPECTING THE LUBRICANT LEVEL ON A TRACTOR.

If you have completed this Learning Activity Package, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given a container for used oil, plug wrenches, the manufacturer's service manual, lubricant, and shop rags, drain and refill the differentials. Both the lubricant and the lubrication level must be correct according to the manufacturer's specifications. Both fill and drain plugs must be tight.

LEARNING ACTIVITIES

1 READ *Tractor Fuels and Lubricants: Selecting and Storing* (AAVIM), pp. 41-45.

(or) _____

2 CHECK YOUR KNOWLEDGE of gear lubricants by taking the Student Self Check, SELECTING GEAR LUBRICANT.

3 CONSULT the manufacturer's service manual for the designated tractor to determine the location of the differential fill plug, differential drain plug, differential oil level plug, and recommended lubricant.

(or) _____

4 READ INSTRUCTIONS, CHANGING DIFFERENTIAL LUBRICANT.

(or) _____

5 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or) _____

6 PRACTICE changing the differential lubricant level of a tractor. Follow the procedure outlined in INSTRUCTIONS and the manufacturer's service manual.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 3.

TOOLS AND EQUIPMENT NEEDED

1. Plug Wrenches
2. Mechanic's Tool Set
3. Manufacturer's Service Manual

MATERIALS AND SUPPLIES NEEDED

1. Clean Rags
2. Lubricant Specified by Manufacturer

SAFETY

When working under the tractor, make sure the wheels are chocked and brakes are set.

INSTRUCTIONS

CHANGING DIFFERENTIAL LUBRICANT

In changing the differential lubricant in a tractor, the following procedure should be used:

1. Clean the surface of filler plug and remove it.
2. Clean the surface of drain plug and remove it.
3. Drain out lubricant for about 5 minutes. (CAUTION: Keep lubricant away from shoes and tires.)

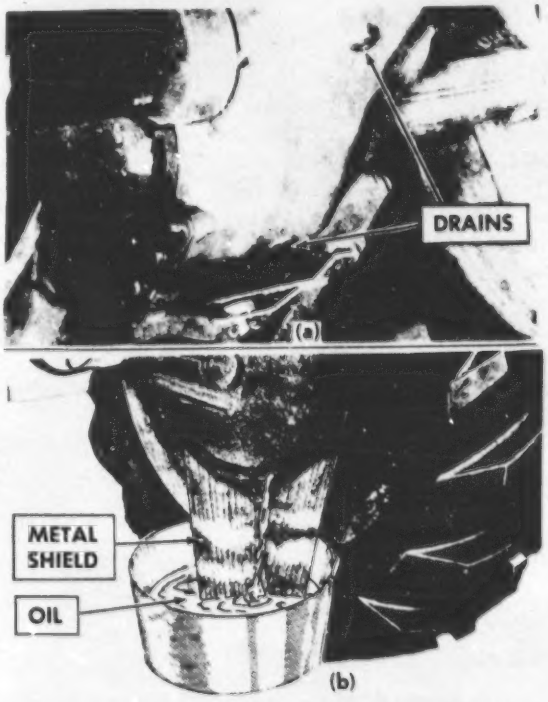


FIGURE 1 (a) Tractor gear cases usually have at least two drain plugs. (b) If there is a spur-gear drive on each rear wheel, use a metal shield to divert the oil away from the tire and into the container. Courtesy of John Deere and Company

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4. When completely drained, replace drain plug.

5. Fill to the correct level with recommended lubricant.

6. Reinsert filler plug.

7. Dispose of used lubricant.

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
SELECTING GEAR LUBRICANT

Answer the following:

1. API means

2. SAE means

3. Which of these is NOT a function of gear lubricants?

   a. Ease movement of gears in cold weather.
   b. Cool the gears.
   c. Reduce friction.
   d. Reduce wear.
   e. Keep metal surfaces apart.
   f. Seal the gear case.

4. SAE viscosity (thickness) numbers will be (higher or lower) for gear oil than for crankcase oil.

5. The additive EP means

6. When in doubt as to which gear oil to use in your tractor, a_____ lubricant is generally acceptable.

7. Gear oils do not wear out; they simply become contaminated. (T or F)

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, CHANGING DIFFERENTIAL LUBRICANT.

Drain and refill the differentials on the designated tractor.

CORRECT RESPONSES

1. American Petroleum Institute
2. Society of Automobile Engineers
3. f
4. higher
5. Extreme Pressure
6. multiple purpose
7. True

DO NOT WRITE ON THIS PAGE

LAP 93

Student _____

Date _____

CHANGING DIFFERENTIAL LUBRICANT

Instructor's Final Checklist

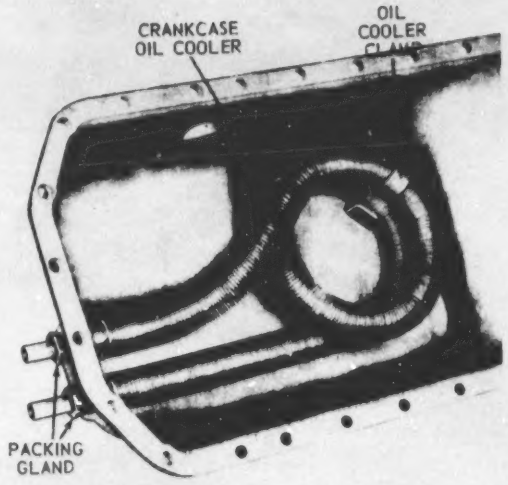
Check the student's performance in the following elements of changing differential lubricant.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
To change the lubricant in the differential of a designated tractor, the student:					
1.	Cleaned the surface of the filler plug	[ ]	[ ]	[ ]	[ ]
2.	Removed the filler plug	[ ]	[ ]	[ ]	[ ]
3.	Cleaned and removed the drain plug	[ ]	[ ]	[ ]	[ ]
4.	Allowed lubricant to drain for about five minutes into a container	[ ]	[ ]	[ ]	[ ]
5.	Replaced the drain plug	[ ]	[ ]	[ ]	[ ]
6.	Filled to the correct level with the recommended lubricant	[ ]	[ ]	[ ]	[ ]
7.	Reinstalled the fill plug	[ ]	[ ]	[ ]	[ ]
8.	Disposed of used lubricant	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 94



Internal Oil Cooler in Crankcase

Courtesy of John Deere and Company

Servicing the Oil Cooler

Tractor Mechanics

Objective no. 135

INTRODUCTION

Because of the large amount of heat produced by an engine, some engines are equipped with oil coolers. Most coolers are of the water-to-oil type. They use the engine coolant to draw heat from the oil. If the oil cooler is not serviced, the passages may become clogged, causing the heat to build up in the oil system. This causes excessive engine heat, resulting in engine wear and/or other damage. In this learning activity package you will learn how to service an engine oil cooler.

DIRECTIONS

Before you begin this learning activity package, be sure you have completed Learning Activity Package 91, INSPECTING THE LUBRICANT LEVEL ON A TRACTOR, and Learning Activity Package 92, CHANGING THE TRACTOR CRANKCASE OIL AND FILTER.

If you have completed these Learning Activity Packages, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, go through the Learning Activities in the order given.

OBJECTIVE

Given a parts cleaning tank, flare-nut wrenches, an air supply and flow gun, a water tank, and the manufacturer's service manual, service the oil cooler. When service is complete, there must be no visible dirt on the cooler and the cooler must be free of leaks.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (Deere & Company), pp. 7-11 through 7-12.

(or) _____

2 READ INSTRUCTIONS, SERVICING THE OIL COOLER.

(or) _____

3 CHECK YOUR KNOWLEDGE by taking Student Self-Check, SERVICING THE OIL COOLER.

(or) _____

4 CONSULT the manufacturer's service manual for the type of cooler and the procedure for removing the oil cooler.

(or) _____

5 EXAMINE the different types of coolers provided by the instructor.

6 PRACTICE servicing the oil cooler of the designated tractor.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 3.

TOOLS AND EQUIPMENT NEEDED

1. Compressor and Flow Gun
2. Parts Cleaning Tank
3. Flare Nut Wrenches
4. Water Tank

MATERIALS AND SUPPLIES NEEDED

Recommended Solvent

SAFETY

When working under a tractor, make sure wheels are checked and brakes set.

INSTRUCTIONS

SERVICING THE OIL COOLER

In servicing the oil cooler, the following procedure should be used:

1. Remove the oil cooler according to the manufacturer's service manual.

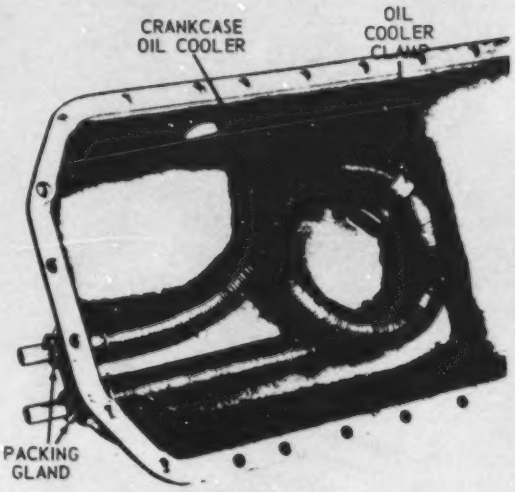


Figure 1. Internal oil cooler in crankcase.

Courtesy of John Deere and Company

2. Blow out the water tubes in the oil cooler with an air hose.
3. Clean the oil tubes with an oil-cleaning solvent. (Dry oil tubes with an air hose.)
4. Check the oil cooler for leaks:
   a. Plug oil outlet.
   b. Install air hose in inlet and turn on air.
   c. Submerge unit in water.
   d. Watch for bubbles. (If no bubbles appear, there is no leakage. If bubbles do appear, locate and repair leaks or replace cooler. Copper coolers can be soldered. Plastic or fiber coolers must be replaced.)
5. Reinstall oil cooler.

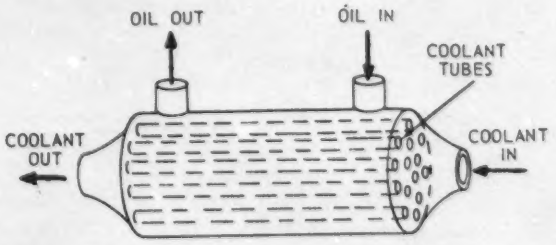


Figure 2. Operation of engine oil cooler.

Courtesy of John Deere and Company

STUDENT SELF-CHECK
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SERVICING THE OIL COOLER

1. The two types of oil coolers are:

2. Most oil coolers use engine coolant to draw heat from the engine. (T or F)

3. Oil coolers are serviced to prevent the oil passages from becoming clogged. (T or F)

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. External, Internal
2. True
3. True. Excess heat can build up causing engine damage if the oil passages become clogged.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING THE OIL COOLER.

Service the oil cooler on the designated tractor.

DO NOT WRITE ON THIS PAGE

LAP 94

Student _____

Date _____

SERVICING THE OIL COOLER

Instructor's Final Checklist

Check the student's performance in the following elements of servicing the oil cooler.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	The student removed the oil cooler according to the manufacturer's service manual	[ ]	[ ]	[ ]	[ ]
2.	The oil cooler was cleaned by the student	[ ]	[ ]	[ ]	[ ]
3.	The leaking oil cooler was repaired or replaced	[ ]	[ ]	[ ]	[ ]
4.	The student reinstalled the oil cooler	[ ]	[ ]	[ ]	[ ]
5.	The oil cooler did not leak when recharged	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 95

Courtesy of John Deere and Company

Preparing a Tractor for Painting

Tractor Mechanics

Objective no. 9

INTRODUCTION

Exposure to weather, grease and oil deposits, rust, scratches, and dents can ruin the appearance of a tractor and decrease its value. To correct this problem, a good paint job is a necessity. But a paint job cannot be a good one unless the tractor is properly prepared for painting. In this learning activity package you will learn how to prepare a tractor for painting.

DIRECTIONS

Before you start to work on this learning activity package, be sure you have completed Learning Activity Package 1, CLEANING THE TRACTOR.

If you have completed this Learning Activity Package, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 5 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, go through the Learning Activities in the order given.

OBJECTIVE

Using necessary repair tools, needed repair parts, and body filler and primer, prepare a tractor for painting.

LEARNING ACTIVITIES

1 VIEW slide-tape presentation TM-95, "Preparing a Tractor for Painting."

(or) _____

2 READ INSTRUCTIONS, PREPARING A TRACTOR FOR PAINTING, and USING BODY PUTTY AND FILLER.

(or) _____

3 STUDY label of body putty and directions for body filler to be used so that you will apply them correctly.

(or) _____

4 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or) _____

5 PRACTICE applying and smoothing body putty and body filler to samples (hood, fender, dash area, and seat) provided by the instructor.

6 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 5.

MATERIALS AND SUPPLIES NEEDED

1. Brazing Rods (coated)
2. Plastic Body Filler or Fiberglass Repair Kit
3. Sandpaper and Sanding Disc
4. Rags, Clean
5. Cleaning Solvent or Compound
6. Primer
7. Masking Tape

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set
2. Body Dollies (anvil, wedge and heel)
3. Wide Nosed Cross Peen Body Hammer
4. Flat Face Body Hammer
5. Flat Round Face Body Hammer
6. Slide Hammer Puller
7. Body Files
8. Assorted Body Spoons
9. Oxy-acetylene Welder
10. Disc Sander
11. Arc Welder
12. Steam Cleaner
13. Air Compressor
14. Spray Gun
15. Protective Clothes
16 Good Painting Mask or Respirator

SAFETY

Use solvents, paint, body filler, and fiberglass resin only in well ventilated areas, away from sparks or flame. Do not breathe vapors.

INSTRUCTIONS

A. PREPARING A TRACTOR FOR PAINTING

1. Thoroughly clean the tractor using a steam cleaner.

Figure 1. Cleaning the tractor with steam.

2. The hood, fender, dash area, and seat should be checked for needed body work.
3. Hammer out any dents and sand any rough areas with 400 grit dry sandpaper.

4. If dents cannot be hammered out, drill small holes in dented area, insert sheet metal screws, and using a block of wood, pull dents out with a claw hammer. Use slide handle puller if available.

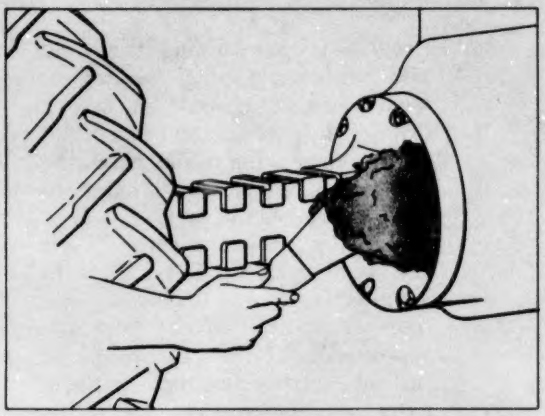

Figure 2. Use a putty knife to remove heavy accumulations.

Courtesy of the American Association for Vocational Instructional Materials

5. Use body putty or filler to smooth out dented and rusted areas. (See Instruction Sheet B)

6. Once sanding is complete, use compressed air to remove the dust from the tractor.

7. Prime any bare spots where body putty was not used.

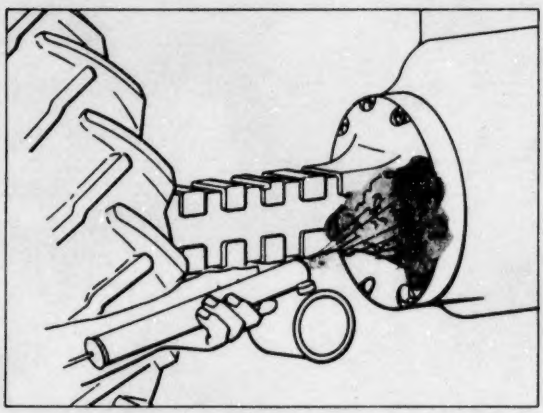

Figure 3. Apply solvent to areas covered with grease and dirt.

Courtesy of the American Association for Vocational Instructional Materials

8. Bathe surface with anti-static solution.

Figure 4. De-greasers are available in (a) small pressure-type cans, or (b) in bulk as a concentrate requiring dilution before being applied.

Courtesy of the American Association for Vocational Instructional Materials

9. Mask with masking tape any areas not to be painted.

10. Move tractor into paint room, set it on axle supports, and remove all four wheels.

INSTRUCTIONS

B. USING BODY PUTTY AND FILLER

There are many different brands of body putty, and it is best to follow the directions on each can. However, the basic procedure for applying body putty is the same for all brands.

1. To repair badly scratched areas:

   a. Sand area by hand with 80 grit dry sandpaper and clean area with compressed air or clean cloth.

b. Apply primer. After it dries, sand the area with 240 grit wet sandpaper and water.
c. Using a special applicator or putty knife, smooth on body putty.
d. When putty dries, smooth surface with 240 grit wet sandpaper and water.
e. Wipe surface clean and apply second coat of primer if necessary.
f. Smooth surface with 400 grit wet sandpaper and water.

Figure 5. Sanding to remove rust and old paint.

2. For badly dented areas, once the dents have been straightened out:

a. Sand area with 400 grit dry sandpaper and clean with compressed air or clean cloth.
b. Fill holes and low areas with body filler approximately two inches (5.08 cm) into surrounding metal surface.
c. After filler cures follow the same procedure as you did for repairing scratches.

Figure 6. Applying body filler.

3. If you have rusted out areas on the tractor:

a. Using a 40 grit sanding disc, sand area with an orbital sander to remove rust and corroded metal.
b. Crimp edges of metal inward and create a depression in the metal.
c. Use a commercial metal patch to cover the rusted out area.
d. Taper edge of patch with 40 grit dry sandpaper to blend it with metal surface.
e. Apply body filler to area approximately two inches (5.08 cm) into surrounding metal surface.
f. After filler cures, sand and shape area with 40 grit dry sandpaper; then smooth the area using the same procedure as you did for scratched areas.

STUDENT SELF-CHECK
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PREPARING A TRACTOR FOR PAINTING

1. List the major steps involved in preparing a tractor for painting.

2. Why do we want to paint a tractor?

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, PREPARING A TRACTOR FOR PAINTING.

Prepare a tractor for painting in the paint area of the shop.

CORRECT RESPONSES

1. Cleaning, removing dents, filling, sanding.

2. A good paint job protects the metal parts of the tractor and increases the value of the tractor.

DO NOT WRITE ON THIS PAGE

LAP 95

Student _____

Date _____

PREPARING A TRACTOR FOR PAINTING

Instructor's Final Checklist

Check the student's performance in the following elements of preparing a tractor for painting.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
In preparing a tractor for painting, the student:				
1. Steam cleaned the tractor	[ ]	[ ]	[ ]	[ ]
2. Hammered out all dents, and applied body putty and filler where needed	[ ]	[ ]	[ ]	[ ]
3. Sanded rough areas	[ ]	[ ]	[ ]	[ ]
4. Cleaned the tractor with compressed air	[ ]	[ ]	[ ]	[ ]
5. Masked with masking tape all areas not to be painted	[ ]	[ ]	[ ]	[ ]
6. Primed bare spots with rust-inhibiting primer	[ ]	[ ]	[ ]	[ ]
7. Applied anti-static solution to surface	[ ]	[ ]	[ ]	[ ]
8. Set up tractor in paint room	[ ]	[ ]	[ ]	[ ]
9. Visually inspected tractor for readiness of painting	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 96

Painting a Tractor

Tractor Mechanics

Objective no. 10

INTRODUCTION

After taking the necessary time to properly prepare a tractor, it is very important to apply the paint correctly. Excessive runs, patchy areas, and large drops of paint can ruin the complete painting process. The best way to correct this possible disaster is to prevent it by learning how to apply a smooth, glossy, and run-free coat of paint. In this learning activity package you will learn the proper procedure for painting a tractor.

DIRECTIONS

Before you start to work on this learning activity package, be sure you have completed Learning Activity Package 1, CLEANING THE TRACTOR, and Learning Activity Package 95, PREPARING A TRACTOR FOR PAINTING.

If you have completed these Learning Activity Packages, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, go through the Learning Activities in the order given.

OBJECTIVE

Given a tractor set-up in a paint room, a spray gun, respirator, and compressed air source, paint the tractor. The completed paint job should be smooth, glossy, and with only minor runs.

LEARNING ACTIVITIES

1 VIEW the slide tape presentation Learning Activity Package 96, "Painting a Tractor,"

(or) _____

2 READ the manufacturer's instruction manual on the spray gun you will be using.

(or) _____

3 LOCATE AND IDENTIFY the parts of the spray gun using the manufacturer's instruction manual as a guide.

(or) _____

4 CHECK YOUR KNOWLEDGE of adjusting a paint gun by taking Student Self-Check, ADJUSTING AND USING A PAINT GUN.

5 READ INSTRUCTIONS, PAINTING A TRACTOR.

(or) _____

6 STUDY the label on the paint can for proper spray mixture.

(or) _____

7 PRACTICE spray painting a piece of metal provided by your instructor. Follow the procedure outlined in INSTRUCTIONS.

8 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 3.

TOOLS AND EQUIPMENT NEEDED

1. Paint Spray Gun
2. Compressed Air

MATERIALS AND SUPPLIES NEEDED

1. Paint Respirators
2. Paint
3. Paint Thinner
4. Rags

SAFETY

1. Provide Ventilation In Paint Room
2. Protect Against Fire Hazards
3. Store Paints In Special Storage Areas

PAINTING A TRACTOR

When painting a tractor, the following procedure should be used:

1. Check room for proper temperature and humidity levels.
2. Set-up paint gun.
3. Set air pressure.
4. Turn on exhaust system.
5. Thin paint if needed.
6. Fill gun reservoir through strainer.
7. Put on respirator.
8. Adjust gun.
9. Paint tractor.

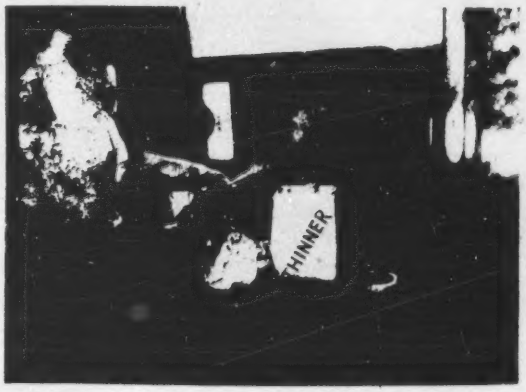

Figure 1. Clean spray gun after each use.

10. Clean gun.
11. Put away equipment.
12. Do not move tractor until paint is dry.

STUDENT SELF-CHECK
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ADJUSTING AND USING A PAINT GUN

Answer the following:

1. A spray gun should be held at a distance of_____to_____inches from the surface being sprayed.

2. A spray gun can be adjusted only for vertical or horizontal spraying. (T or F)

3. When painting the top of a hood or fender, how should you hold the paint gun?

4. When spraying form left to right and right to left on a vertical surface, how should you move the paint gun?

5. You should release the_____of the spray gun at the end of each pass.

Compare your answers with the correct responses at the bottom of the page. Review any incorrect answers before going on to the next Learning Activity.

CORRECT RESPONSES

1. 6 to 8 in. (15 to 20 cm).
2. False
3. straight over surface pointing gun down
4. parallel to surface and not in an arc
5. trigger

CHECK-OUT ACTIVITIES **LAP 96**

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, PAINTING A TRACTOR.

In the paint area of the shop, paint a tractor.

DO NOT WRITE ON THIS PAGE

LAP 96

Student _____

Date _____

PAINTING A TRACTOR

Instructor's Final Checklist

Check the student's performance in the following elements of painting a tractor.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In painting the tractor, the student:				
a. prepared the paint room and the paint gun for painting	[ ]	[ ]	[ ]	[ ]
b. prepared the paint	[ ]	[ ]	[ ]	[ ]
c. filled gun reservoir through strainer	[ ]	[ ]	[ ]	[ ]
d. put on respirator	[ ]	[ ]	[ ]	[ ]
e. adjusted gun	[ ]	[ ]	[ ]	[ ]
f. painted tractor	[ ]	[ ]	[ ]	[ ]
g. cleaned gun and put away the equipment	[ ]	[ ]	[ ]	[ ]
2. The completed paint job was smooth, glossy, and free of major runs	[ ]	[ ]	[ ]	[ ]